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**IDENTIFICATION AND ANALYSIS OF SELECTED
HIGH PRIORITY WATER PROBLEMS AND
RELATED RESEARCH NEEDS OF THE
MISSOURI RIVER BASIN**

1978

COMPLETION REPORT



**MISSOURI RIVER BASIN REGION
WATER RESOURCES RESEARCH INSTITUTES
APRIL 1976**

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IDENTIFICATION AND ANALYSIS OF SELECTED HIGH
PRIORITY WATER PROBLEMS AND RELATED RESEARCH NEEDS
OF THE MISSOURI RIVER BASIN

by
Missouri River Basin
Water Institute Consortium

Project Number X-135-Neb.
Agreement Number - OWRT-USDI 14-31-0001-9079

March 1973 - March 1976

COMPLETION REPORT

March 1976

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PROJECT TITLE: IDENTIFICATION AND ANALYSIS OF SELECTED HIGH PRIORITY
WATER PROBLEMS AND RELATED RESEARCH NEEDS OF THE MISSOURI
RIVER BASIN

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DATES: March 1973 with original closing date of March 1975 extended
to March 1976

PROJECT OBJECTIVES:

- (1) Identify the principal water resources problems of the Missouri River Basin.
- (2) Determine the most reasonable alternatives for solving these problems.
- (3) Identify research needed to permit cost-effective solutions.
- (4) Evaluate mechanisms to implement the needed research.
- (5) Assign priorities, estimate approximate costs and evaluate funding opportunities.

RELEVANCE OF RESEARCH:

The Missouri Basin is the largest single region designated by the Water Resources Council. It includes all or part of ten states and has a varied climate, geology and topography. There are problems of water excess and deficiency. Urban and rural extremes exist, and almost every conceivable water-related issue can be identified.

Federal agencies in the Missouri River Basin are charged with developing a comprehensive regional plan for effective development and management of the area's resources. Individual state agencies are also heavily involved in planning activities. To complement these programs, additional data and research are needed. This project is assessing these needs and evaluating procedures for implementing the required research.

RESEARCH PROCEDURES:

MRBWIC

The Missouri River Basin Water Institute Consortium (MRBWIC) was formulated in 1972 by the Institute Directors within the Missouri Basin for the purpose of coordinating research planning and implementation pertaining to regional water problems. It is an informal organization having an elected chairman and secretary. The Directors of eight states, Nebraska, Missouri, Kansas, Wyoming, North Dakota, South Dakota, and Iowa have actively participated as co-investigators with the Colorado Director playing a vital but less active role. The Director of Minnesota served as an observer. Each state possessed unique strengths in various disciplines so that collectively there is available a well trained, experienced authority for each and every aspect of the broad water resources field.

The project made possible a close and important liaison with the Missouri River Basin Commission. The Commission, formed in July 1972 with representation from state and federal water agencies, is the focal point for water resources planning. Their comprehensive framework study, a continuing endeavor, enables planners and developers to perceive future needs for knowledge in advance of the need. This is an essential step in programming effective research.

REGIONAL RESEARCH WORKSHOP CONCEPT

The Consortium used the workshop approach in the identification of high priority water problems. The initial workshop was held in Lincoln, Nebraska in June 1973 at which time twenty-three priority areas were identified. Subsequent evaluation in 1974 by the principal investigators caused ten priority areas to be analyzed in detail. The reports of the workshops which were held in the various states refined the specific research need and offered alternative solutions to the problems. These are reported in a March 1975 publication entitled "Identification and Analysis of Selected High Priority Water Problems and Related Research Needs of the Missouri River Basin".

Subsequent to this effort, the Consortium exerted a continuing effort in identifying high priority water problems. Problem areas were identified in accordance with a matrix classification formulated by the Office of Water Research and Technology (Department of the Interior). This report includes the water research priorities for the Missouri River Basin states as determined for fiscal year 1978. It is expected that this is not the final effort, but continuing updating will be necessary.

REGIONAL
WATER RESOURCES PROBLEMS
AND
RESEARCH BUDGET NEEDS

WATER RESOURCES RESEARCH PRIORITIES
FOR
THE MISSOURI RIVER BASIN STATES
FISCAL YEAR 1978

A cooperative Water Resources Research Program was established in each of the Missouri River Basin States following passage of the Water Resources Research Act of 1964. Since the initiation of this program both practical and basic research on various water problems have been conducted. There are many examples where a single state research study has shown dollar return greater than the entire cost of the total of individual state expenditures. The institutes have worked closely with both state and federal agencies. Recently there has been major emphasis on regional water problems. This thrust has pointed to the most efficient use of available funds and studies on most important problems. Closer coordination of efforts between the Office of Water Research and Technology (Department of the Interior) and the states has resulted in the designation of eight regions. These regional groups assist in outlining the research areas where water problems are the most critical. This report outlines regional problems of the Missouri River Basin where funds are needed in fiscal year 1978. The Classification Matrix (Form OW-417) and Problem Projection (Form OW-418) were prepared by the Office of Water Research and Technology and was used by all of the states in the Missouri Basin. A summary is included with the results of this report.

The Missouri River Basin covers one-sixth of the contiguous United States and is the largest of the OWR regional groupings. It includes all or part of 10 states. (This report covers data from Iowa, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota and Wyoming.) Rainfall varies from over 40 inches in the eastern part to only 10-15 inches annually in the western portion. Uneven distribution of rainfall contributes to summer droughts, and most of the major streams produce flood problems, either from excessive precipitation events or rapid snow melt.

In the western portion of the basin water supplies are fully utilized and over appropriation deserves additional study. There is competition for water for irrigation-energy developments, new industries and recreation. Agriculture is the major user of water, although large urban centers are developing and industry is growing--where water supplies will permit. In the higher rainfall areas, (eastern portion), periodic summer droughts are stimulating supplemental irrigation of grain and forage crops. High costs of machinery and farm operations jeopardize the farm investment when lack of precipitation reduces crop yields.

This region produces most of the nation's wheat and large quantities of other grains including corn and soybeans. Livestock production, meat packing and food and grain processing are major industries. These agribusinesses require large amounts of water, and treatment of wastes to prevent stream pollution. Current requirements of PL 92-500 regarding non-point sources of pollution affect most of the farms. There are extensive areas of grazing land. The region has long conducted research on soil erosion--to save soil for the future. Emphasis has now shifted to the study of sediment as the major water pollutant. Sediment may be the primary carrier of other pollutants, which adhere to soil particles in suspension. Fertilizers and farm chemicals are extensively used in grain production. The fate and contribution of these materials to water pollution are largely unknown and practical research is needed to achieve results which can lead to improved management practices.

The water supplies in the Missouri Basin states figure prominently in the national energy picture. Wheat is the principal commodity for export to pay for foreign oil. Corn and soybeans are also important export items. These export commodities are critical in maintaining a favorable balance of trade. Major U.S. deposits of coal and oil shales are in this area. A limited amount (or distant location) of water supplies is a constraint on technology. Relationships of extensive uranium and lead deposits with water supplies are also of concern. Research is required to best utilize limited water supplies in the basin to attain national self-sufficiency in energy and mineral supplies.

WATER RESOURCES PROBLEM PROJECTION

Directors of the Water Resources Centers and Institutes of the Missouri Basin States have worked with the local state and federal agencies in projecting future needs for water studies. The table on page 8 is a summary of data from the OW-417 forms, prepared by individual states, showing a classification of problems listed as "critical or severe." Summaries of all states at two levels of allotment funding (\$110,000 and 250,000 annually) and three levels of matching support (\$50, \$150,000 and available non-federal funds) are listed in tables, pages 9 through 13.

These summaries show that all four of the problem areas are of regional importance. There are only small differences in percentage allocation of proposed funding for 1978 at the two levels of allotment funding. About 60 percent is listed for Water Quantity and Water Quality Problems. Environmental Impact and Water Planning and Management are considered important in

most states, with a slightly larger percentage of increased funds to be used for the former.

At the lowest level of matching funds 44.1 percent is suggested for studies of Water Quality, pointing to problems in the low rainfall areas, and the effects of coal and oil shale developments on water pollution. Water Planning is listed as only 12.8 percent at this lowest level of matching funds. At the higher level of matching funds a larger percentage is designated for Water Planning and Management. Although there are some differences in emphasis in the eastern and western extremes of the basin, major regional problems are considered to be in the area of Water Quantity. At low levels of funding Water Quality is also of high priority. Should additional research funding be provided a larger percentage will be devoted to Environmental Impact and to Water Planning and Management research needs.

PRIORITY AREAS

I. WATER QUANTITY

A. Control of Excess Water

Three states in the eastern portion of the Basin (Iowa, Kansas and Missouri) consider flooding and management of excess water major problems. Most precipitation occurs from April to September and some storms are heavy. Correlation between precipitation and flooding is not exact, but the problem is the greatest in the lower part of the basin. Flood problems include the need for studying flood plain management implementation strategies in a social--economic--institutional framework, evaluating the impact of urbanization, potential need for additional agricultural drainage improvements, channel stabilization and bank erosion problems and the physical erosion potential under high-level agricultural production. In the western areas where rainfall is low, or where a major portion of the available water is from snow-melt, excess water is an infrequent problem.

B. Water Supply Augmentation and Conservation

This is a problem area given high priority by all of the states in the basin. In the western portion there is a deficiency of water and most available supplies are fully allocated. There are areas where ground water depletion is serious. Coal and oil shale developments require water. Urban and industrial developments are limited by existing water supplies. There is much concern for increased future demands. There is much interest in basin transfer. Increased upstream demands for irrigation and requirements

for coal processing are reducing (and will continue to reduce) the flow of the lower Missouri. Large transportation and waste disposal are affected. In the eastern portion, frequent summer drouths jeopardize crop production. Interest in supplemental irrigation is growing. There is interest for utilizing flood water during periods of drouth or transferring river water to border or interior counties. Additional studies of water allocation throughout the basin are needed.

II. WATER QUALITY

A. Control of Entering Pollutants

All eight states listed need for research on pollution problems (particularly non-point sources) as they apply to both surface and ground waters. Losses and fate of farm chemicals and fertilizers to water supplies are considered problems by most states. Other water quality problems are created by erosion, sediments, logging operations, cattle grazing and various coal and other mining operations. States in the lower rainfall areas have questions regarding natural sources of salts (saline seeps), flow irrigation problems, and seep areas developing from the construction of large reservoirs. To meet the requirements of PL 92-500 there is need for information on the use of sewage effluent for crop irrigation, and for land disposal of both urban and agricultural (livestock) organic waste residues.

B. Effects of Pollutants

There are many unanswered questions on the effect of various pollutants. Problems differ from those in other sections of the nation. Sediment as a pollutant deserves additional attention. Biological effects of farm chemicals on Missouri basin lakes and closed basins are largely unknown. Many shallow aquifers have been the source of domestic supplies when lower depths are too highly mineralized for domestic use. Coal developments pose an unknown for areas with limited supply or where the existing water being used is of inferior quality. Land management is changing and there is little basic information on the influence of man's activities on water quality.

C. Water Treatment Processes and Disposal of Wastes

Most concern in this problem area is related to requirements of PL 92-500. Population of the area is much less than in the states east of the Mississippi River. However, major effort is being made to improve the quality of the Missouri River. There is need for information that will permit the

use of sewage effluent and water treatment wastes to be efficiently applied to agricultural land. In the region where evaporation exceeds precipitation the quality of irrigation return flow is of major concern.

III. ENVIRONMENTAL IMPACT

A. Economic Effects

Emphasis in this problem area is generally associated with large reservoirs. There are conflicts between citizens who want to emphasize recreation, and those interested in other beneficial uses such as flood control, water supply and fish and wildlife propagation. Criteria other than economic values need to be developed and evaluated. There is a lack of sound information for the preparation of impact statements on new projects that are in the planning stages. Studies are needed to provide information on the usefulness of multipurpose reservoirs, and problems that may develop. Because of the high nutrient contents of sediments, the erosiveness of some soils and the economy in the basin, data from other parts of the nation are of only limited value.

B. Ecosystem Effects

Most states listed ecosystem effects as an area where information was needed, but largely as a lower priority area than where water quantity or quality is concerned. Many of the specific problems are related to seeps and return irrigation flows to larger reservoirs. There is a lack of knowledge on the biological effects of different materials on the lakes. There is public interest on improvement of the Missouri River. However, the input of those participating in this evaluation considered this problem to require long-time effort and assigned it a lower priority.

C. Public Welfare Effects

Future energy-water relations in the Missouri Basin States will have national implication. The Missouri Basin people have the same concerns and problems as in more populated areas-- particularly near the larger towns. There is general appreciation for "wide open spaces" and natural conditions, with increased economic growth being subordinated by many citizens. Since water resources are critical throughout the region there is demand for in-depth studies that will permit economic growth, but provide recreation and preserve the best natural conditions. Of particular concern is the development of energy reserves and maintain the food production potential. It is just being recognized that public water

supply districts, to bring quality water to farm areas, is having environmental impacts far beyond the health of farm people or providing livestock water. Questions raised about this influence in population shifts from urban areas is a subject where there are few facts.

A shorter work week, in addition to gasoline shortages and increased prices, has stimulated interest of the basin people in water recreation closer to home. Additional information is needed for the management of water resources that will provide for the greatest good without degrading some natural conditions. There is much local sentiment that this region profit from the experiences of areas with greater populations and more industrial development. However, much data now in existence (from other areas) is of limited value without studies to incorporate the different environmental conditions that exist.

IV. WATER PLANNING AND MANAGEMENT

A. Institutions; B. Methods and Procedures; and C. Basin Data

Water planning and management varies widely from state to state. Some have active planning programs, while others have done little, and in some states there is public opposition to rigid programs. The individual state comments (appendix) list numerous areas where information is needed. It is evident that lack of basic data, the variation in water resources problems within this vast area, and methods that will meet general public acceptance have hindered planning. All of the states have listed work in this area as needed, with special attention being given to assisting each state's resource agencies in comprehensive planning programs. Information dissemination and publication distribution are key needs in the planning coordination phase. As each state complies with the comprehensive planning requirements, coordinated by the Water Resources Council, through the basin organizations, the role of the institute as a research arm will ever be more evident.

SUMMARY OF MATRIX EVALUATION

An evaluation was made of priorities and research needs, using the OWRT Form OW-417. The water research classification matrix for each institute was combined in a weighing process to evaluate the basin results. A value of 2 was assigned to each "critical" designation in the matrix, and a value of 1 to each "serious" designation. The values were then summed for the eight states in the Missouri basin. The results are listed in the matrix as shown in the accompanying sheet.

In terms of problem areas, the matrix shows that the following water resources problem areas have highest priority:

1. Water supply augmentation and conservation
2. Control and effects of pollution
3. Ecosystems effects
4. Methods and procedures for planning and management

In terms of the research systems and processes, the following listing shows the hydrologic, biological, sociological, planning & management, engineering, and data acquisition items of greatest importance. These are:

1. Water-soil interface
2. Channel flow
3. Groundwater, including wells and recharge systems
4. Watershed, river, and lake ecosystems
5. Biochemical impacts
6. Economic factors
7. Legal factors
8. Problem identification, plan evaluation, and decision making
9. Water treatment (believed to be related to renewed concern with drinking water standards)
10. Water supply engineering
11. Eutrophication control
12. Irrigation
13. Hydrologic, biologic, and sociological data acquisition, and information systems

Examination of the matrix, in detail, permits one to identify specific research needs. For instance, water treatment and methods and procedures of analyzing the economic impact of water resources are the research items receiving the greatest priority, each having a weight of 11. Other key but specific research areas are also evident. However, the matrix is more valuable in a broader sense, as outlined above.

Therefore, it can be concluded that several areas of importance have been identified, and research needs are broadly but clearly defined. Values above 4 (from 4 to 11) might be considered the highest priority needs. Thus a research direction is provided for the institutes in the MRBWIC group. These results will enable MRBWIC directors to develop an expanded regional research program, with the assistance and cooperation of the federal Office of Water Research and Technology.

RESEARCH WILL DEAL WITH THESE SYSTEMS & PROCESSES

SYSTEMS & PROCESSES (RESEARCH)	I. HYDROLOGICAL										II. BIOLOGICAL					III. SOCIOLOGICAL					IV. PLANNING & MGT.					V. ENGINEERING					VI. DATA ACQUISIT.				
	A	B	C	D	E	F	G	H	I	J	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
Atmospheric																																			
Water-Soil Interface																																			
Channel Flow																																			
Lakes, Estuaries																																			
Groundwater																																			
Ice, Permafrost																																			
Snow																																			
Watershed Ecosystems																																			
River Ecosystems																																			
Lakes, Estuaries																																			
Bio-Chemical																																			
Political Action																																			
Public Information																																			
Goal Indicators																																			
Economic																																			
Legal																																			
P&M Organizations																																			
Problem Identification																																			
Action, Design																																			
Plan Evaluation																																			
Decision-Making																																			
Operations																																			
Construction																																			
Water Treatment																																			
Wells, Recharge Sys.																																			
Flood Protection																																			
Water Supply																																			
Navigation																																			
Eutrophication Control																																			
Brosion, Sed. Control																																			
Irrigation																																			
Watershed Improvement																																			
Hydrologic Data																																			
Biologic Data																																			
Sociologic Data																																			
Engineering Data																																			
Information Storage																																			
Transfer Systems																																			

CLASSIFICATION LEGEND:

C - Critical Assigned Value 2

NATIONAL ASSOCIATION OF WATER INSTITUTE DIRECTORS
WATER RESOURCE BUDGET PROJECTION FOR FISCAL YEAR 1978

Region: Missouri River Basin

Date: December 1975

State Institutes:

\$110,000 Allotment

Iowa

Kansas

Missouri

Montana

Nebraska

North Dakota

South Dakota

Wyoming

	I o w a	K a n s a s	M i s s o u r i	M o n t a n a	N e b r a s k a	N D a k o t a	S D a k o t a	W y o m i n g	T o t a l	Percent	
										A	M*
										l	a
										t	t
										c	h
										m	i
										n	n
										g	g
PROBLEM AREAS											
I. WATER QUANTITY PROBLEMS											
A. Control of Excess Water	20	23.5		10			15		68.5	7.8	4.7
B. Water Supply Augmentation and Conservation	10	39.3	10	50	10	10	15	20	164.3	18.6	14.6
C. Water Utilization					30				30	3.4	9.6
D. Water Allocation								20	20	2.3	1.6
E. Instream Flow								10	10	1.2	1.6
II. WATER QUALITY PROBLEMS											
A. Control of Entering Pollutants		15.1	15	10		10	20	10	80.1	9.1	10.2
B. Effects of Pollution	20	11.1	10	10	15	30	10	10	116.1	13.3	10.4
C. Water Treatment Processes and Disposal of Wastes	10	5	20	5	10	10	5		65	7.4	7.0
III. ENVIRONMENTAL IMPACT											
A. Economic Effects	10		5	10	5	10	5	10	55	6.2	10.0
B. Ecosystems Effects	20	11	10	5	10	15	10	10	91	10.3	12.1
C. Public Welfare Effects			10		5	10	5		30	3.4	4.6
IV. WATER PLANNING & MANAGEMENT											
A. Institutions	20		10	5	5		10	10	60	6.8	4.8
B. Methods & Procedures		5	10	5	15	10	15	10	70	7.9	6.7
C. Basic Data			10		5	5			20	2.3	2.1

Dollars in thousands (,000 - omitted)

*Based on \$150,000 of matching money.

NATIONAL ASSOCIATION OF WATER INSTITUTE DIRECTORS
WATER RESOURCE BUDGET PROJECTION FOR FISCAL YEAR 1978

Region: Missouri River Basin

Date: December 1975

State Institutes:

\$250,000 Allotment

Iowa
Kansas
Missouri
Montana
Nebraska
North Dakota
South Dakota
Wyoming

	I o w a	K a n s a s	M i s s o u r i	M o n t a n a	N e b r a s k a	N D a k o t a	S D a k o t a	W y o m i n g	T o t a l	Percent A l l o t m e n t	Percent M a t c h i n g
PROBLEM AREAS											
I. WATER QUANTITY PROBLEMS											
A. Control of Excess Water	20	44	20	20		20	40		164	8.2	2.9
B. Water Supply Augmentation and Conservation	30	59	30	100	20	20	30	40	329	16.5	25.2
C. Water Utilization					80				80	4.0	12.5
D. Water Allocation								30	30	1.5	2.5
E. Instream Flow								20	20	1.0	
II. WATER QUALITY PROBLEMS											
A. Control of Entering Pollutants	30	40	30	30		30	30	10	200	10.0	5.6
B. Effects of Pollution	30	15	30	30	35	40	20	20	220	11.0	12.5
C. Water Treatment Processes and Disposal of Wastes	25	25	30	10	30	20	10	10	160	8.0	3.8
III. ENVIRONMENTAL IMPACT											
A. Economic Effects	25	13	10	20	10	20	20	25	143	7.1	10.0
B. Ecosystems Effects	30	17	20	15	15	50	30	20	197	9.8	11.4
C. Public Welfare Effects	10	7	20	5	10	20	10	10	92	4.6	1.1
IV. WATER PLANNING & MANAGEMENT											
A. Institutions	20	10	20	5	10	10	30	15	120	6.0	5.0
B. Methods & Procedures	20	20	20	10	30	10	30	40	180	9.0	7.5
C. Basic Data	10		20	5	10	10		10	65	3.3	0

Dollars in thousands (,000 - omitted)

*Based on \$50,000 matching.

NATIONAL ASSOCIATION OF WATER INSTITUTE DIRECTORS
WATER RESOURCE BUDGET PROJECTION FOR FISCAL YEAR 1978

Region: Missouri River Basin

Date: December 1975

State Institutes:

\$50,000 Matching

Iowa
Kansas
Missouri
Montana
Nebraska
North Dakota
South Dakota
Wyoming

	I o w a	K a n s a s	M i s s o u r i	M o n t a n a	N e b r a s k a	N D a k o t a	S D a k o t a	W y o m i n g	T o t a l	States Involved	
										A* l l o t m e n t	M a t c h i n g
PROBLEM AREAS											
I. WATER QUANTITY PROBLEMS											
A. Control of Excess Water		11.5							11.5	4	1
B. Water Supply Augmentation and Conservation	15	15.5	5	40			15	10	100.5	8	6
C. Water Utilization					50				50		1
D. Water Allocation										1	
E. Instream Flow								10	10	1	1
II. WATER QUALITY PROBLEMS											
A. Control of Entering Pollu- tants		7.5	10				5		22.5	6	3
B. Effects of Pollution	15	5	10			10	10		50	8	5
C. Water Treatment Processes and Disposal of Wastes		5	10						15	7	2
III. ENVIRONMENTAL IMPACT											
A. Economic Effects						20	10	10	40	7	3
B. Ecosystems Effects	10	5.5				20		10	45.5	8	4
C. Public Welfare Effects			5						5	5	2
IV. WATER PLANNING & MANAGEMENT											
A. Institutions	10						10		20	6	2
B. Methods & Procedures			10	10				10	30	7	2
C. Basic Data										3	0

Dollars in thousands (,000 - omitted)

*Based on \$110,000 of allotment money.



NATIONAL ASSOCIATION OF WATER INSTITUTE DIRECTORS
WATER RESOURCE BUDGET PROJECTION FOR FISCAL YEAR 1978

Region: Missouri River Basin

Date: December 1975

State Institutes:

\$150,000 Matching

Iowa
Kansas
Missouri
Montana
Nebraska
North Dakota
South Dakota
Wyoming

	I o w a	K a n s a s	M i s s o u r i	M o n t a n a	N e b r a s k a	N D a k o t a	S D a k o t a	W y o m i n g	T o t a l	States Involved	
										A*	M
										l l o t m e n t	a t c h i n g
PROBLEM AREAS											
I. WATER QUANTITY PROBLEMS											
A. Control of Excess Water	10	25.5					10	10	55.5	6	4
B. Water Supply Augmentation and Conservation	20	40	20	50			25	20	175	8	6
C. Water Utilization					115				115	1	2
D. Water Allocation								20	20	1	1
E. Instream Flow								20	20	1	1
II. WATER QUALITY PROBLEMS											
A. Control of Entering Pollu- tants	20	21.5	25	30			15	10	121.5	7	6
B. Effects of Pollution	20	15	15	20		25	20	10	125	8	7
C. Water Treatment Processes and Disposal of Wastes	15	15	20			25		10	85	8	5
III. ENVIRONMENTAL IMPACT											
A. Economic Effects	15	5	10	20	20	20	20	10	120	8	8
B. Ecosystems Effects	15	10	10	20		50	20	20	145	8	7
C. Public Welfare Effects	5	5	15			30			55	8	4
IV. WATER PLANNING & MANAGEMENT											
A. Institutions	10	3	15	10			20		58	8	5
B. Methods & Procedures	15	10	10		15		20	10	80	8	6
C. Basic Data	5		10					10	25	6	3

Dollars in thousands (,000 - omitted)

*Based on \$250,000 allotment.

NATIONAL ASSOCIATION OF WATER INSTITUTE DIRECTORS
WATER RESOURCE BUDGET PROJECTION FOR FISCAL YEAR 1978

Region: Missouri River Basin

Date: December 1975

State Institutes:

Maximum State Matching

Iowa
Kansas
Missouri
Montana
Nebraska
North Dakota
South Dakota
Wyoming

	I o w a	K a n s a s	M i s s o u r i	M o n t a n a	N e b r a s k a	N D a k o t a	S D a k o t a	W y o m i n g	T o t a l	States Involved	
										A* l l o t m e n t	M a t c h i n g
PROBLEM AREAS											
I. WATER QUANTITY PROBLEMS											
A. Control of Excess Water	15	76.5	10	75			50	10	236	6	6
B. Water Supply Augmentation and Conservation	35	120	20				30	50	255	8	5
C. Water Utilization					242				242	1	1
D. Water Allocation								50	50	1	1
E. Instream Flow								30	30	1	1
II. WATER QUALITY PROBLEMS											
A. Control of Entering Pollu- tants	25	64.5	40	30		25	30	10	224	7	7
B. Effects of Pollution	40	45	30	30		75	20	20	260	8	7
C. Water Treatment Processes and Disposal of Wastes	40	45	30	10		25	10		160	8	6
III. ENVIRONMENTAL IMPACT											
A. Economic Effects	35	15	15	30		75	50	20	240	8	7
B. Ecosystems Effects	25	30	20	40		100	40	50	305	8	7
C. Public Welfare Effects	15	15	15	10		75	10	10	150	8	7
IV. WATER PLANNING & MANAGEMENT											
A. Institutions	30	9	20	10			30	20	119	8	6
B. Methods & Procedures	25	30	20	20	75	15	20	10	215	8	8
C. Basic Data	15		10	10	53	10	10	50	158	6	7
Total	300	450	230	265	370	400	300	330	2,645		

Dollars in thousands (,000 - omitted)

*Based on \$250,000 of allotment money.

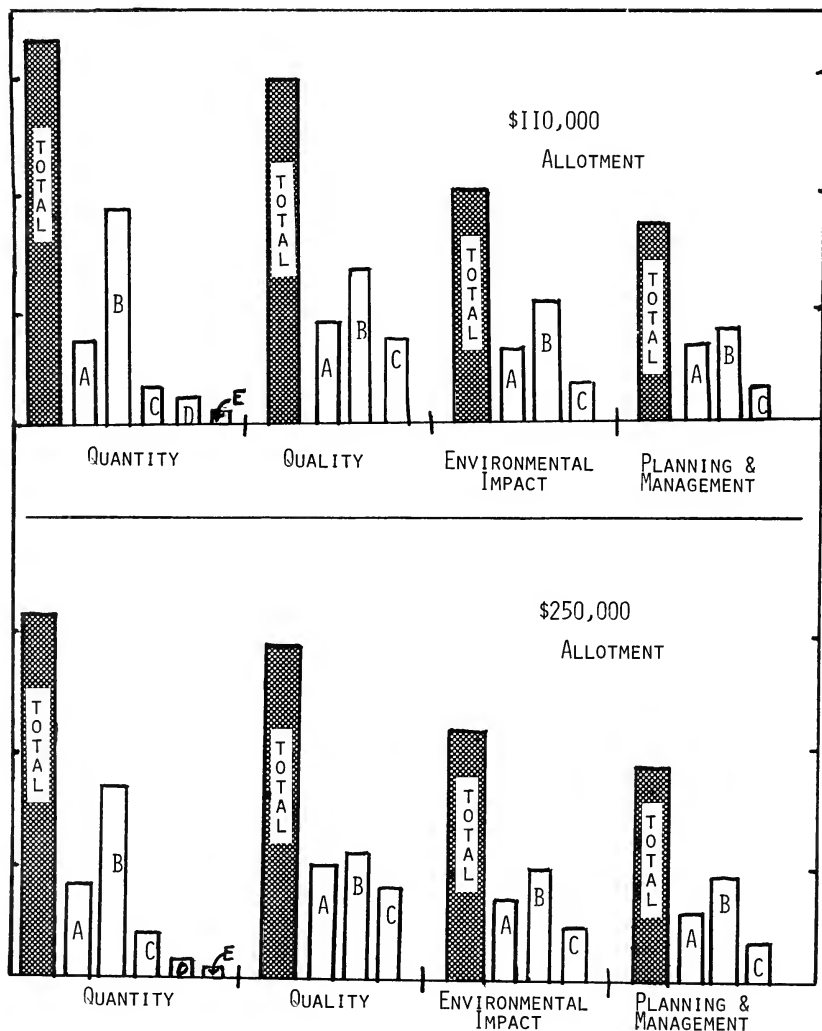


FIGURE 1 PROJECTED BUDGET DISTRIBUTION FOR FY 1978 BY PROBLEM AREA CATEGORIES FOR TWO LEVELS OF ALLOTMENT FUNDS

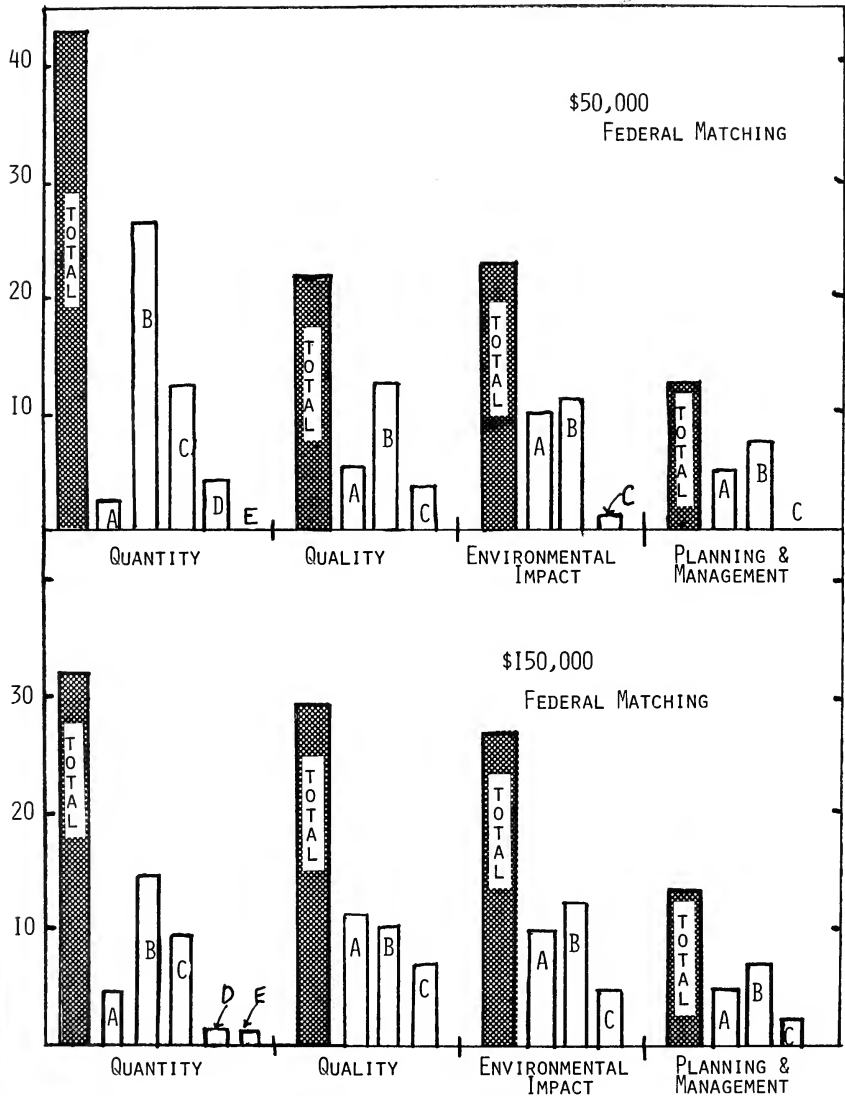


FIGURE II PROJECTED BUDGET DISTRIBUTION FOR FY 1978 BY PROBLEM AREA CATEGORIES FOR TWO LEVELS OF FEDERAL MATCHING FUNDS



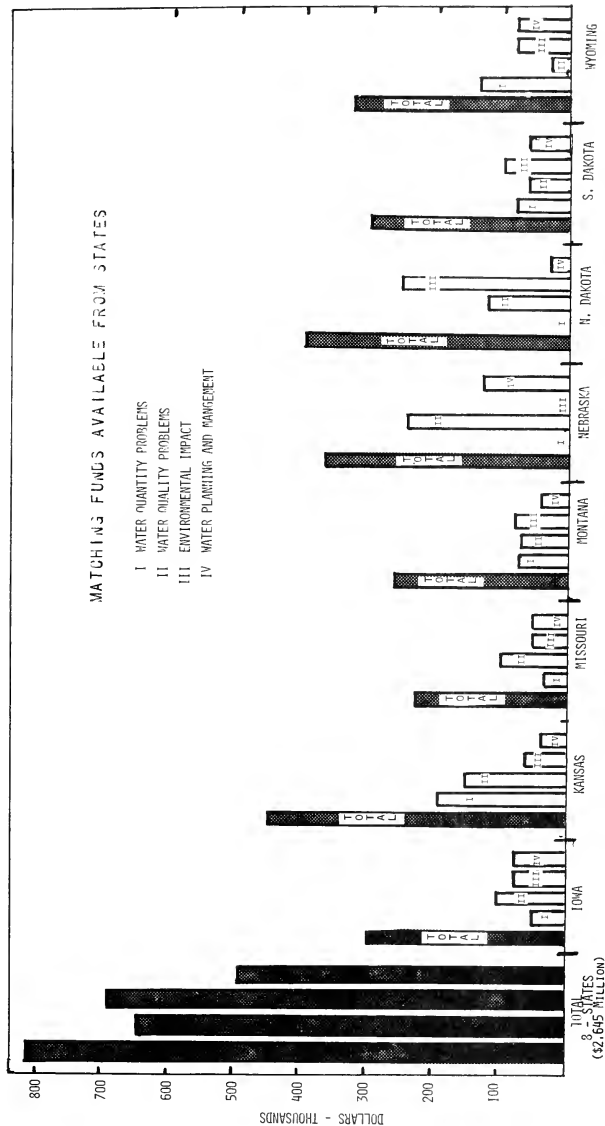


FIGURE 3. PROJECTIONS OF MATCHING FUNDS, BY STATES, AVAILABLE FOR WATER RESOURCES RESEARCH IN FY 1978

IOWA'S
WATER RESOURCES PROBLEMS
AND
STUDY NEEDS

MERWIN D. DOUGAL, DIRECTOR
IOWA STATE WATER RESOURCES
RESEARCH INSTITUTE

IOWA STATE WATER RESOURCES RESEARCH INSTITUTE
FY 1978 Research Budget Needs and Projections

IOWA -- CRITICAL WATER PROBLEMS

1. Impact of floods as excess water

Flood problems continue to beset the state. Identified problems include the need for studying flood plain management implementation strategies in a social-economic-institutional framework, evaluating the impact of urbanization, potential need for additional agricultural drainage improvements, channel stabilization and bank erosion problems and the physical erosion potential under high-level agricultural production.

2. Supply availability problems and augmenting existing supplies

Research needs have been identified in several key areas. These include the need for augmenting and providing additional water supplies for southern and western Iowa. Supplemental irrigation demand may create problems along the border and the major interior streams having wide alluvial flood plains. The transfer of water from the border rivers into the border and interior counties may become a real need in view of the current drought potential. The allocation of the waters of the Missouri River also is of great interest to Iowa, and evaluation of the impact of upstream demands for irrigation and energy must be made.

3. Meeting beneficial water use requirements

Allocation of water in Iowa, among the recognized beneficial use groups, will become an important factor in state water planning. Allocation or control of the piezometric head in groundwater aquifers is a key problem that now faces the state. Additional study of the need for and impact of increased demands for municipal, industrial, and energy uses and their competition with recreation and other uses has been outlined through problem analysis. Eight beneficial user groups are included in the current Iowa framework study for water planning: water use by municipal, industrial and rural regional; agricultural needs; flood plain management; water quality enhancement; outdoor recreation; fish and wildlife improvement; water for energy production; and navigation and river transportation.

4. Groundwater quality protection

Groundwater quality in Iowa has deteriorated in many locations. The impact of leachates from solid-waste disposal sites is of special interest as relatively new state regulations are implemented. Many problems also have been encountered in areas where rural residential

growth has been accelerated. Study of management systems and technical factors associated with individual household waste disposal systems is just underway, and a 5-year need has been outlined. Drainage wells exist in northern Iowa, and their impact has never been studied in detail. Loss of well pumping capacity with time is another chronic problem facing the owners of water wells, and improved well design is a new objective.

5. Erosion and sediment control in Iowa

The land erosion potential under high level agricultural production is staggering. The ability of erosion and sediment control programs to solve the problem is seriously challenged by the introduction of large scale farming equipment through high level technology. A multidisciplinary technical-social-economic-institutional study of the problem is dictated by the complex nature of the problem.

6. Water quality enhancement and pollution control

The impact of point and non-point source pollution on Iowa's streams and lakes is great. Low flow characteristics of Iowa's streams are poor, except for the far northeast part of the state. Management programs of several types have been proposed for study. Additional technical, social, and economic interrelationships need to be included in the proposed investigations. Key management programs have been outlined for: non-point source pollution; lake management; reservoir water quality improvement; and in water pollution control. Advanced waste treatment at point pollution sources requires further study, as energy and material problems make previous solutions unacceptable to municipal and industrial leaders, or difficult to implement under current funding limitations. Management and control of non-point source pollution will involve both agricultural and non-agricultural sources. Technical, social and economic factors must be evaluated to determine the management level which will best serve the state.

7. Environmental impact of water resources development

The usefulness of the large multipurpose reservoirs in Iowa is being identified and evaluated in research studies. The technical studies now being made need to be supplemented by social, economic, and institutional studies for further knowledge. Improved management programs will evolve from these studies. Additional application and in-depth studies of recreation demand and economic benefits gained by nearby communities also have been requested by state and federal agencies. The environmental impact of other water resources facilities and from the several beneficial water use groups also warrants attention. These include studies of Iowa's key recreation lakes as well as the major border rivers, the Missouri and Mississippi Rivers.

8. Water resources management program in Iowa

Studies in the operations, planning and management area would be directed to several key areas. One is a proposed review of the Little Sioux River watershed management program that includes tributary small watershed projects and main-channel river improvements. A second planning and management study entails the regional operation of dispersed individual water pollution control plants, with centralized laboratory facilities as the first real need and general operation and systems management as further needs. The third area involves the development of regional (rural) water systems in Iowa. The fourth is need for the development, legislative enactment and implementation of water quality management districts in the recreation lake regions in Iowa. A fifth is a developing need for analysis of natural resource regions in Iowa, in a combined land-timber-mineral-water resource picture, and in a long term perspective.

IOWA STATE WATER RESOURCES RESEARCH INSTITUTE
FY 1978 Research Budget Needs and Projections

<u>Problem Areas and Research Needs Descriptions</u>	<u>Coordinates of Critical/Severe Research Needs Associated With Problems</u>	
	<u>Problem Area(s) Coordinate</u>	<u>Research Classification Coordinate</u>
1. Impact of floods, flood damage reduction in urban and agricultural areas, further implementation of statewide flood plain management program	I-A	I-B(s) I-C(c) III-A to E (s) IV-B,C,D(s) IV-E,F(c) V-D,J(s) V-H(c) VI-A,C(s)
2. Augmenting water supplies in areas deficient in moisture availability, surface water yield and having ground water quality problems	I-B	I-D(s) I-E(c) II-C(s) III-C(s) III-D,E(c) IV-A,E(s) IV-B,D(c) V-C,E(s) VI-A,D(s)
3. Meeting beneficial use requirements, including allocation of water in competing circumstances	I-B	I-E(c) II-C(s) III-C(s) III-D,E(c) IV-D,E(c) IV-E(s) V-A,E(s) VI-A-E(s)
4. Protection of groundwater quality through control of solid waste residues, of individual household waste disposal systems, and impact of trace pollutants and other non-point pollution sources	II-A II-B	I-E(c) II-D(c) III-A,C(s) III-E(c) IV-A,C,D,E,F(s) V-A,C(s) I-B(s) I-E(c) II-B(s) II-D(c) III-B,D(s) V-C(s) VI-A-E(s)

Problem Areas and
Research Needs Descriptions

Coordinates of Critical/Severe
Research Needs Associated With Problems

	<u>Problem Area(s)</u> <u>Coordinate</u>	<u>Research</u> <u>Classification</u> <u>Coordinate</u>
5. Land erosion potential under high level agricultural production and alternative management programs	II-A	II-B(s) IV-A,C,F(s) II-C,D(c) IV-B,D(c) III-A-C(s) V-G,H (c) III-D,E(c) V-J (s) VI-F(s)
	II-B	I-B,C,D(s) II-B(c) IV-H(s) II-C(c) VI-A-E(s) III-B,D(s) V-A,H(s)
6. Water quality improvement of surface-water streams and lakes, as impacted by point and non-point sources of pollution, and as might be improved through management programs and advanced waste treatment facilities	II-A	II-B(s) IV-A,C,F(s) II-C,D(c) IV-B,D(c) III-A-C(s) V-G,H(c) III-D,E(c) V-J (s) VI-F(s)
	II-B	I-B,C,D(s) II-B(c) IV-H(s) II-C(c) VI-A-E(s) III-B,D(s) V-A,H(s)
	II-C	I-D(s) IV-D(s) I-E(c) IV-E(c) II-D(c) V-B,C,E(s) III-D(s) VI-D(s)
7. Environmental impact assessment and beneficial use of the large multipurpose reservoirs in Iowa, and of other multipurpose water resources programs	III-A	I-E,F(s) IV-D(c) III-C,E(s) V-D,E,F(s) III-D(c) V-G,H,J(c) IV-B,E,F(s) V-I(s)
	III-B	I-C,D(s) V-D,H,J(s) I-E(c) V-G(c) II-B,C(s) VI-A,F(s) II-D(c) VI-B,C(c) III-A(s)
	III-C	III-A,B,C(s) III-D,E(c) IV-A,C(s) VI-C,F(s)

Problem Areas and
Research Needs Descriptions

Coordinates of Critical/Severe
Research Needs Associated With Problems

	Problem Area(s)	Research Classification Coordinate	
8. Management program evaluation and needs, for (a) selected watershed management systems; (b) regional operation of dispersed individual water pollution control plants, (c) rural-regional water supply systems; and (d) state water plan needs	IV-A	I-E(s)	IV-F(c)
		III-A(s)	V-B,H,J(s)
		III-D,E(c)	V-E,G(c)
		IV-A,D,E(s)	VI-C(s)
	IV-B	IV-B(c)	
		I-B(s)	IV-B,D,E(s)
		I-C(c)	V-B,H,J(s)
		III-A,B,C(s)	V-E,G(c)
	IV-C	III-D,E(c)	VI-C(s)
		I-C(s)	V-C,E,I,J(s)
		I-E(c)	VI-B,C,E,F(s)
		II-B,C(s)	
		II-D(c)	

OFFICE OF
WATER RESEARCH AND TECHNOLOGY

WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: IOWA STATE WATER RESOURCES RESEARCH INSTITUTEREGION: MISSOURI BASINDATE: 10-10-75

For FISCAL YEAR 1978

PROBLEM AREAS	Allotment		Matching			TOTAL
	\$110*	\$250*	\$50*	\$150*	\$300 *	
I. WATER QUANTITY PROBLEMS						
A. Control of Excess Water	20	20	--	10	15	
B. Water Supply Augmentation and Conservation	10	30	15	20	35	
II. WATER QUALITY PROBLEMS						
A. Control of Entering Pollutants	--	30	--	20	25	
B. Effects of Pollution	20	30	15	20	40	
C. Water Treatment Processes and Disposal of Wastes	10	25	--	15	40	
III. ENVIRONMENTAL IMPACT						
A. Economic Effects	10	25	--	15	35	
B. Ecosystems Effects	20	30	10	15	25	
C. Public Welfare Effects	--	10	--	5	15	
IV. WATER PLANNING & MANAGEMENT						
A. Institutions	20	20	10	10	30	
B. Methods & Procedures	--	20	--	15	25	
C. Basic Data	--	10	--	5	15	
Total	110	250	50	150	300	

CLASSIFICATION LEGEND

C - Critical

S - Severe

KANSAS
WATER RESOURCES PROBLEMS
AND
STUDY NEEDS

WILLIAM L. POWERS, DIRECTOR
WATER RESOURCES RESEARCH INSTITUTE

CRITICAL PROBLEMS OF THE STATE OF KANSAS

<u>Problem Areas and Research Needs Descriptions</u>	<u>Problem Area(s) Coordinate</u>	<u>Research Classification Coordinate</u>
<p>1. <u>Flood Frequency Predictions from Heavy Summer Thunderstorms</u></p> <p>In all parts of the state about 75% of the precipitation occurs between April and September. Summer thunderstorms in excess of 5 inches of rainfall have been recorded in nearly every part of the state. Although rainfall is the primary cause of floods, there is no exact correlation between rainfall amount and flood discharge. Analysis of flood frequency data along with prediction models will help control the damaging effects of heavy rainfall.</p>	I-A	I-C II-A III-S
<p>2. <u>Improving Water Use Efficiency</u></p> <p>Municipalities, industry and agriculture all utilize groundwater, but irrigation is by far the greatest user of water in Kansas. Groundwater use is predicted to rise from 2.4 maf in 1965 to 8.0 maf in 2000 with agriculture utilizing 90% of the withdrawal. During the same period municipal and industrial use of groundwater is expected to grow 270%. During this interval, surface water withdrawals will change from 1.1 to 6.2 maf annually. Depletion of groundwater reserves results from over-pumping. These reserves may be essentially depleted in 4 counties by 2000 and in 19 counties by 2050. It is therefore important that research be done on conservation methods of increasing water use efficiency for both industry and agriculture.</p>	I-B	I-C I-E IV-D
<p>3. <u>Allocation and Management of Water</u></p> <p>Water quantity is a serious research area in the state of Kansas. Planning and management needs exist for the use of scarce quantities of water. Allocation of surface impoundment water has become an important question in the state of Kansas. Pricing practices and groundwater aquifer management will become serious research problems in the near future. Therefore, additional research is needed on pricing and allocation methods for water in the state of Kansas.</p>	IV-B	I-C I-E II-A II-B III-D V-B V-E

RESEARCH WILL DEAL WITH THESE SYSTEMS & PROCESSES

<u>SYSTEMS & PROCESSES</u> <u>(RESEARCH)</u>		I.	II.	III.	IV.	V.	VI.
		HYDROLOGICAL	BIOLOGICAL	SOCIOLOGICAL	PLANNING & MGT.	ENGINEERING	DATA ACQUISIT.
<u>PROBLEM AREAS</u>		A Atmospheric	A Water-Soil Interface	A Political Action	A P&M Organizations	A Construction	A Hydrologic Data
		B Channel Flow	B Lakes, Estuaries	B Public Information	B Goal Indicators	B Flood Protection	B Biologic Data
		C Groundwater	C River Ecosystems	C Economic	C Action, Design	C Wells, Recharge Sys.	C Sociologic Data
		D Ice, Permafrost	D Marshes Ecosystems	D Legal	D Plan Evaluation	D Water Supply	D Engineering Data
		E Lakes, Estuaries	E Bio-Chemical	E Operations	E Decision-Making	E Navigation	E Information Storage
		F Transfer Systems	F Lakes, Estuaries	F Problem Identification	F Irrigation	F Eutrophication Control	F Transfer Systems
<u>I. WATER QUANTITY</u>							
A. Control of Excess Water							
B. Water Supply Augmentation and Conservation							
<u>II. WATER QUALITY</u>							
A. Control of Entering Pollutants							
B. Effects of Pollution							
C. Water Treatment Processes and Disposal of Wastes							
<u>III. ENVIRONMENTAL IMPACT</u>							
A. Economic Effects							
B. Ecosystems Effects							
C. Public Welfare Effects							
<u>IV. WATER PLANNING & MANAGEMENT</u>							
A. Institutions							
B. Methods & Procedures							
C. Basic Data							

CLASSIFICATION LEGEND:

C - Critical

S - Severe

KANSAS

OFFICE OF
WATER RESEARCH AND TECHNOLOGY

FORM 67-410
(7/75)

WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: Kansas

DATE: Sept. 1975

REGION: Missouri River Basin

FISCAL YEAR 1978

PROBLEM AREAS	Allotment		Matching			TOTAL
	110,000	250,000	50,000	150,000	unlimited	
I. WATER QUANTITY PROBLEMS						
A. Control of Excess Water	23,500	44,000	11,500	25,500	76.5	
B. Water Supply Augmentation and Conservation	39,300	59,000	15,500	40,000	120	
II. WATER QUALITY PROBLEMS						
A. Control of Entering Pollutants	15,100	40,000	7,500	21,500	64.5	
B. Effects of Pollution	11,100	15,000	5,000	15,000	45	
C. Water Treatment Processes and Disposal of Wastes	5,000	25,000	5,000	15,000	45	
III. ENVIRONMENTAL IMPACT						
A. Economic Effects		13,000		5,000	15	
B. Ecosystems Effects	11,000	17,000	5,500	10,000	30	
C. Public Welfare Effects		7,000		5,000	15	
IV. WATER PLANNING & MANAGEMENT						
A. Institutions		10,000		3,000	9	
B. Methods & Procedures	5,000	20,000		10,000	30	
C. Basic Data						
TOTAL					450	

CLASSIFICATION LEGEND

C - Critical

S - Severe

MISSOURI'S
WATER RESOURCES PROBLEMS
AND
STUDY NEEDS

GEORGE E. SMITH, DIRECTOR
WATER RESOURCES RESEARCH CENTER

MISSOURI - CRITICAL WATER PROBLEMS

PROBLEM AREAS:

I. Reduction of Flooding and Conserving Water for Supplemental Irrigation:

Average rainfall in Missouri is in excess of all needs. Floods are common on both the Missouri and Mississippi Rivers in many years. However, in many seasons, within a few weeks after heavy runoff summer crop production is jeopardized by seasonal moisture deficiency. The demand for grains in foreign exchange and the high cost inputs in crop production point to the need for preventing runoff during periods of floods and storage for use as supplemental irrigation in rainfall deficient periods. Competition is developing between agriculture, urban areas and recreational use for water supplies in some areas. Adequate river channel depths for barge transportation and increased requirements for new energy developments are future water quantity problems.

II. Non-point and Point Sources of Water Pollution:

Provisions of Public Law 92-500, concerned with non-point sources of water pollution are of much concern to Missouri farm people. As the demand for food production is emphasized the use of farm chemicals in Missouri will continue to grow. Additional information is needed on the fate of farm fertilizers and pesticides. How much of these materials is from urban areas and how much is from farm land? Feed-lot runoff (and grazing land), crop and mining residues must be associated with soil erosion (both rural and urban) to prevent stream degradation that must be evaluated with needed economic development. New waste water and water treatment residue disposal regulations are increasing costs. There is concern for the necessity of these requirements. Land use patterns are rapidly changing the quality of runoff water. These amounts must be understood. Point sources of contamination are better documented than non-point, but much information now being used is largely opinions--not facts.

Underground water supplies differ widely in quality depending on the area and the depth of the aquifer. There is concern about surface leachates (mostly rural areas) on shallow aquifers where deeper supplies are highly mineralized. Missouri is a major mining state. There is much concern for the effect of these operations on the quality of both ground and surface waters. Missouri has long been concerned about the role of trace substances in animal and human health. There is much interest in both the effect of the ions occurring naturally in water and substances that could enter from man's activities.

Missouri - Critical Water Problems

Gasoline shortages are increasing the population pressure on the use of Missouri reservoirs and clear streams for recreation. Pollution from mining, urban areas and agricultural operations are largely unknown. There is need for information that will keep these water resources of highest quality for the people of the midwest.

III. Land Use Changes and Water Resources:

There are varied interest groups with strong views on water resource developments in the state. In the northern part planned multiple purpose reservoirs cover some of the best agricultural lands. South of the Missouri River the naturalist, who wants to keep clear swiftly moving streams is opposed by reservoir enthusiasts and the need for hydropower and water supplies for urban and industrial use. When impact statements are prepared opinions rather than facts are frequently used in presenting economic, ecosystems and public welfare effects.

IV. Water Planning and Management:

Missouri has done relatively little planning of water resources. Our larger cities obtain water from the rivers. New water quality laws require changes in water and waste water treatment and disposal. The state is affected by periods of excess rainfall--both within the state and runoff from states to the north and west. We need to manage water that causes floods and drainage problems so it will reduce flooding and can be utilized during summer drouths. There are sections of the state where multiple use lakes are needed that include provision for water recreation. A large part of the water in the Missouri River is from other states and the regulation of flow requires regional management. Additional research is required before adoption of a state water law.

RESEARCH NEEDSCoordinates of Critical/Severe
Research Needs Associated With Problems

	Problem Area(s) Coordinate	Research Classification Coordinate*
I. Reduction of Flooding and Conserving Water for Supplemental Irrigation	I-B	I-E(s) II-C(s) III-B(s) III-D V-H V-J VI-F(s)
II. Non-Point and Point Sources of Water Pollution	II-A	I-C I-D II-A III-B III-C IV-E V-H V-I VI-B VI-F
	II-B	I-E V-E
	II-C	II-D(s) III-D(s) IV-C(s) V-B V-I
III. Environmental Impacts	III-A	I-C(s) V-J(s)
	III-B	I-C I-D III-B(s) V-I
	III-C	I-C I-D III-B(s) V-I

IV. Water Planning and Management

Problem Area(s) Coordinate	Research Classification Coordinate*
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IV-A

III-S

IV-B

IV-E

IV-C

V-I

RESEARCH WILL DEAL WITH THESE SYSTEMS & PROCESSES

[illegible]

MISSOURI

OFFICE OF
WATER RESEARCH AND TECHNOLOGY

WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: MissouriDATE: 10-1-75REGION: Missouri Basin

FISCAL YEAR

PROBLEM AREAS	Allotment *		Matching*			TOTAL
	\$110	\$250	\$50	\$150	Unlimited	
I. WATER QUANTITY PROBLEMS						
A. Control of Excess Water		20			10	
B. Water Supply Augmentation and Conservation	10	30	5	20	20	
II. WATER QUALITY PROBLEMS						
A. Control of Entering Pollutants	15	30	10	25	40	
B. Effects of Pollution	10	30	10	15	30	
C. Water Treatment Processes and Disposal of Wastes	20	30	10	20	30	
III. ENVIRONMENTAL IMPACT						
A. Economic Effects	5	10		10	15	
B. Ecosystems Effects	10	20		10	20	
C. Public Welfare Effects	10	20	5	15	15	
IV. WATER PLANNING & MANAGEMENT						
A. Institutions	10	20		15	20	
B. Methods & Procedures	10	20	10	10	20	
C. Basic Data	10	20		10	10	
TOTAL	110	250	50	150	230	

CLASSIFICATION LEGEND

C - Critical

S - Severe

*Dollars in thousands (,000 omitted)

MONTANA'S
WATER RESOURCES PROBLEMS
AND
STUDY NEEDS

HELMER HOLJE, DIRECTOR
MONTANA UNIVERSITY JOINT
WATER RESOURCES RESEARCH CENTER

MONTANA-CRITICAL WATER PROBLEMS

<u>PROBLEM AREA AND RESEARCH NEEDS DESCRIPTION</u>	<u>PROBLEM AREA (s) COORDINATE</u>	<u>RESEARCH CLASS- IFICATION</u>
1. <u>Supply Availability Problems</u>	I B	I-BE III-BDE IV-E V-EHIJ VI-BCD
One of the more critical water resources problem areas in Montana concerns water availability. With the increasing water demands for all sectors a very intense competitive situation is developing between and among water users and uses. For example, a long-term adjudication is underway on the Yellowstone. Already the water demands exceed the water supplies several fold. However, with proper research, planning and development there should be sufficient water for the foreseeable future.		
2. <u>Water Quality Degradation</u>	II AB	II-BC III-DE
The problem of a slow but ongoing degradation of water quality in almost every stream and river in Montana can only be solved by knowledge of the quantities and sources of pollutants from both point and non-point land use activities. In the state of Montana, as in most Missouri Basin states, logging, cattle grazing, mining and subdivisions are land use activities whose impacts upon water quality are not well defined. It is most important that research be undertaken to generate recommendations for practical safeguards and land-use methods for minimizing water quality degradation. It is likewise important to determine what the economic and sociological costs are when these safeguards are not established.		
3. <u>Regional Water Management</u>	III BC IV AB	II-A IV-BE VI-C III-DE
Water resources are not constrained by political boundaries, and for many management problems it is necessary to recognize the regional nature of water resources research, planning and development. With increasing use of water by all sectors of the economy, it is vital that the approach to water resource use be on a regional and national basis. As an example, one needs only to look at the coal-energy development taking place in the Fort Union Formation of Montana, North Dakota and Wyoming. The problem of water development and use includes economic, legal, sociological and institutional constraints which require substantial research in order to find a satisfactory solution to the many and varied problems.		

RESEARCH WILL DEAL WITH THESE SYSTEMS & PROCESSES

SYSTEMS & PROCESSES (RESEARCH)	RESEARCH WILL DEAL WITH THESE SYSTEMS & PROCESSES					
	I. HYDROLOGICAL	II. BIOLOGICAL	III. SOCIOLOGICAL	IV. PLANNING & MGT.	V. ENGINEERING	VI. DATA ACQUISIT.
PROBLEM AREAS	Atmospheric	A				Hydrologic Data
	Water-Soil Interface	B				Biologic Data
I. WATER QUALITY	Channel Flow	C				Sociologic Data
	Lakes, Estuaries	D				Engineering Data
A. Control of Excess Water	Groundwater	E				Information Storage
	Ice, Permafrost	F				Transfer Systems
B. Water Supply Augmentation and Conservation	Watershed Ecosystems	A				
	River Ecosystems	B				
II. WATER QUALITY	Lakes, Estuaries	C				
	Bio-Chemical	D				
A. Control of Entering Pollutants						
B. Effects of Pollution						
C. Water Treatment Processes and Disposal of Wastes						
III. ENVIRONMENTAL IMPACT						
A. Economic Effects						
B. Ecosystems Effects						
C. Public Welfare Effects						
IV. WATER PLANNING & MANAGEMENT						
A. Institutions						
B. Methods & Procedures						
C. Basic Data						

CLASSIFICATION LEGEND:
C - Critical
S - Severe



OFFICE OF
WATER RESEARCH AND TECHNOLOGY

WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: MONTANADATE: 10/10/75REGION: MISSOURI

FISCAL YEAR 1978

PROBLEM AREAS	ALLOTMENT		MATCHING		TOTAL
	\$110	\$250	\$50	\$150	
					Unlimited
I. WATER QUANTITY PROBLEMS					
A. Control of Excess Water	10	20			75
B. Water Supply Augmentation and Conservation	50	100	40	50	
II. WATER QUALITY PROBLEMS					
A. Control of Entering Pollutants	10	30	-0-	30	30
B. Effects of Pollution	10	30	-0-	20	30
C. Water Treatment Processes and Disposal of Wastes	5	10			10
III. ENVIRONMENTAL IMPACT					
A. Economic Effects	10	20	-0-	20	30
B. Ecosystems Effects	5	15	-0-	20	40
C. Public Welfare Effects	-0-	5	-0-	-0-	10
V. WATER PLANNING & MANAGEMENT					
A. Institutions	5	5			10
B. Methods & Procedures	5	10	10	10	26
C. Basic Data	-0-	5	-0-	-0-	10
TOTAL					265

CLASSIFICATION LEGEND

C - Critical

S - Severe

NEBRASKA'S
WATER RESOURCES PROBLEMS
AND
STUDY NEEDS

MILLARD W. HALL, DIRECTOR
WATER RESOURCES RESEARCH INSTITUTE

NEBRASKA - CRITICAL WATER PROBLEMS

Problem Areas and
Research Needs
Description

Coordinates of Critical/
Severe Research Needs
Associated with Problem

Problem Area(s)
Coordinate

Research
Classification
Coordinate*

I. Effective Utilization of the Water Supply

Much of Nebraska lacks sufficient precipitation to supply water for agriculture and other purposes. Because of the shortage of rainfall, irrigation is increasingly important as one progresses westward across the state. In addition to agricultural uses, growing urban needs and the demand for water based recreational opportunities compete for Nebraska's limited water supply.

I-B

I-B(s)
I-E(s)
III-B(s)
III-C
III-E(s)
V-B
V-C
V-E
V-I
V-J(s)

In some areas, the recent rapid expansion of irrigation has led to serious depletion of underground reservoirs with alarming declines in the level of groundwater. To ease the seasonal tax on the water supply and minimize evapotranspiration losses, the possibility of storage in some aquifers should be evaluated as well as the potential of recharge systems. Improved techniques for the recovery and reuse of excess water from irrigated areas are also needed.

II-A

III-C
III-E(s)
V-B(s)
V-C
V-E(s)
V-F(s)

In addition, most of the irrigation systems being introduced are pump systems which expand the problem of energy consumption. Additional research is needed to insure that water pumped for irrigation is used by the crop in an optimal fashion, i.e., no over irrigation or wasting of water through irrigation of the wrong crop, or at the wrong time.

III-C

III-C(s)

Existing mechanism for allocating and regulating water supplies need to be examined and possible legislative remedies proposed and evaluated. In terms of allocation, interrelationship between ground and surface water must be examined and defined to develop a balanced program to satisfy conflicting water demands. Because of the critical nature of water availability in many areas of Nebraska, maximum efficiency must be achieved in the use of water by all sectors of society. This includes consideration of the minimum acceptable receiving water flow for transporting and diluting wastes as well as determining the minimal water requirements of industries.

*Those marked (s) are severe and should be investigated within 3 to 5 years.
Those not marked are critical and should be investigated within 1 to 2 years.



II. Diffuse and Point Sources of Contaminants

Information on the magnitude and distribution of nonpoint pollution sources in Nebraska is virtually nonexistent. Data collection, monitoring, and analysis is needed to determine the sources, extent and location of such pollution so that rules and standards for water quality maintenance can be rationally established.

II-A

II-C
II-D
III-C(s)
III-E
VI-B
V-G
V-H

Nebraska's soils are highly susceptible to erosion, which leads to the need for understanding of the processes of sediment detachment and transport. The development of analytical models to predict the morphological behavior of eroding systems is a requirement for adequate long term control measures. Specific research on the effect of sediments on stream biota is also needed. The relationships between plant nutrients from diffuse runoff and the water quality of receiving lakes and streams must be defined more precisely. Much additional work is needed to evaluate the fate of herbicides, pesticides, and fungicides in the environment resulting from the movement of these materials through the soils and water and the possible harmful effects on wildlife and human populations as a result of recycling this water.

II-B

II-C
II-D

II-C

III-C(s)
III-E(s)
V-B
V-G
V-H

III-C

III-C

Although more thoroughly studied than diffuse pollution, most of the efforts for control of point source pollution have been in the areas of treatment, collection and disposal of urban, domestic and industrial wastewaters. Quantification of the magnitude and type of pollution as well as further understanding of the effects of such pollution is needed in addition to practical methods for control of these contaminants. The biological effects of a large number of pollutants are unknown as are economic treatment systems for enormous volumes of water. Research is also needed on the necessary quality of waters for a variety of recycle and reuse systems.

III. Lake and Reservoir Quality Degradation

Lakeshore development, sedimentation and runoff from agricultural lands, feedlots and urban areas are placing increasing stress on the quality of both manmade and natural lakes in Nebraska. Little is known regarding the bio-physical-chemical interactions that occur in lakes and reservoirs although there has been extensive research. Much basic research is needed for the development of quantitative models of these interactive systems.

II-A

II-C
IV-B(s)

II-B

II-C
II-D
III-C
IV-B

Safe and economical methods for controlling eutrophication of lakes and reservoirs and the manifestations of this phenomenon are still needed although there have been years of research in these areas. The biological control of this type of pollution is needed as well as analytical models for classifying lakes and reservoirs in accordance with their trophic status and for predicting shifts in this status resulting from man-induced stresses. Also, there is a definite need for interpretation and dissemination of research results in this area.

V-G
V-H

IV. Planning Methodologies

The limited water supply in Nebraska and the increasing demand on it require the most efficient management and planning systems possible. Planning and management processes associated with land and water development encompass economic, technical, social, political, and legal aspects which need to be researched individually. The complex systems which incorporate these aspects must also be investigated. Though much has been learned about the processes involved in planning, there is a great need to provide methodologies which treat planning regions as comprehensive systems reflecting interaction between physical, environmental, and human factors. Areas which need improved management techniques must be evaluated in terms of existing legal, political, social, and economic constraints, and the impacts of slackening or removing these constraints must be studied as a mechanism for suggesting change.

IV-B
III-B(s)
III-C
III-D(s)
III-E(s)
IV-B
IV-C
IV-D(s)
IV-E(s)

IV-C
VI-A(s)
VI-B(s)
VI-C(s)
VI-E

Techniques for the identification and measurement of objectives must be improved and further emphasis must be placed on developing interrelationships between objectives. Additional research is also required for identifying the various trade-offs in different alternatives and for establishing pricing practices consistent with plan utilization.

Planning and management also depend on data from which analyses can be made and theories tested. The traditional approaches to data gathering need review, and conventional data networks need modernizing. Research directed toward the design of comprehensive environmental data-collection and monitoring systems is important. Another necessity to receive the full benefits from developments made is the complete documentation and instruction for the effective utilization for the models which are developed.





OFFICE OF
WATER RESEARCH AND TECHNOLOGY

WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: NEBRASKAREGION: Missouri BasinDATE: 10/15/75

FISCAL YEAR 1978

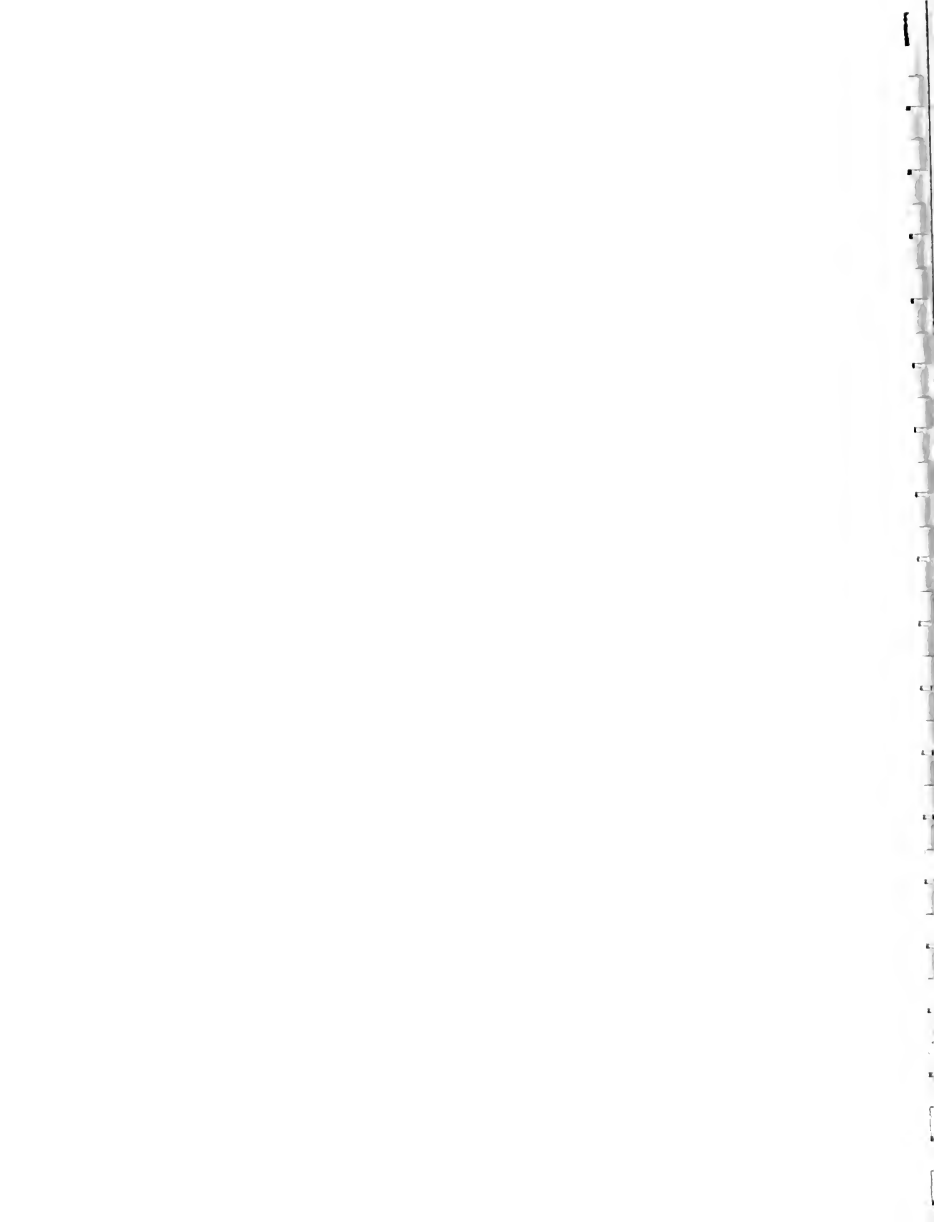
PROBLEM AREAS	Allotment		Matching*		
	\$110	\$250	\$50	\$150	unlimited
I. WATER QUANTITY PROBLEMS					
A. Control of Excess Water					
B. Water Supply Augmentation and Conservation	10	20			
C. Water Utilization	30	80	50	115	242
II. WATER QUALITY PROBLEMS					
A. Control of Entering Pollutants					
B. Effects of Pollution	15	35			
C. Water Treatment Processes and Disposal of Wastes	10	30			
III. ENVIRONMENTAL IMPACT					
A. Economic Effects	5	10		20	
B. Ecosystems Effects	10	15			
C. Public Welfare Effects	5	10			
IV. WATER PLANNING & MANAGEMENT					
A. Institutions	5	10			
B. Methods & Procedures	15	30		15	75
C. Basic Data	5	10			53
TOTAL	\$110	\$250	\$50	\$150	\$370

CLASSIFICATION LEGEND

C - Critical

S - Severe

* These ceilings do not reflect reality in Nebraska. We will undoubtedly submit proposals requiring more than \$300,000 in matching funds.



NORTH DAKOTA'S
WATER RESOURCES PROBLEMS
AND
STUDY NEEDS

ROBERT KOOB, DIRECTOR
WATER RESOURCES RESEARCH INSTITUTE

NORTH DAKOTA CRITICAL WATER PROBLEMS

<u>Problem Areas and Research Needs Descriptions</u>	<u>Problem Areas</u>	<u>Systems and Processes</u>
1. <u>Energy Development.</u> The impact on quantity and quality of water caused by the introduction of major new water consuming industry in the state is now of critical concern both regionally and nationally. The aspects of this problem appear innumerable. Who decides who gets how much water? How? What pre and post treatments are necessary, if any, for water used by a gasification plant? An electric utility? A fertilizer manufacturer? etc... How are effluents to be handled? Will evaporation affect weather? Will stream discharge harm rivers? Will holding ponds affect groundwater? Immediate action, in the form of site specific studies using newly constructed plants, is required. From specific examples generalization to usable guidelines for future activities may be generated.	II B II C III A III B IV B	I B,E; II A-D; VI B V B III D II A-D II B
2. <u>Water Management in Closed Basins.</u> In a "closed" (no effluent streams) basin, the impact of one kind of water management action on other parameters becomes more apparent than usual. In one area in North Dakota (Devils Lake Basin) conflicts have grown to crisis proportions. In the arena: farm owners and operators faced with sheet flooding in four of the last seven years and government owned and leased wetlands; U.S. Fish and Wildlife Service trying to pressure an important natural resource (prairie pothole wetlands); and the city of Devils Lake which could lose as much as one-half of the incorporated community to a rising Devils Lake. The most beneficial compromise to all citizens must be reached but causes of the problem and effects of recommended action must be determined. A basin wide study including hydrological parameters, environmental units, sociological parameters, economics and law have begun. It is critical that this program is continued and expanded.	I A III A III B III C	III A,B I D; II A I D; II A I D; II A
3. <u>Irrigation.</u> The impact of the Garrison Diversion on water quality on different river basin systems, one of which drains into Canada, has been seriously questioned by those with environmental concerns. Irrigation practices, leaching effects and return flow volumes and quality must be determined for model projects.	I B II A II B III B	II A,B I B-E II A, B I C, II B

RESEARCH WILL DEAL WITH THESE SYSTEMS & PROCESSES

SYSTEMS & PROCESSES
(RESEARCH)

PROBLEM AREAS

WATER QUANTITY

Control of Excess Water
Water Supply Augmentation
and Conservation

I. WATER QUALITY

Control of Entering
Pollutants
Effects of Pollution
Water Treatment Processes
and Disposal of Wastes

II ENVIRONMENTAL IMPACT

	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025	2025-2026	2026-2027	2027-2028	2028-2029	2029-2030	2030-2031	2031-2032	2032-2033	2033-2034	2034-2035	2035-2036	2036-2037	2037-2038	2038-2039	2039-2040	2040-2041	2041-2042	2042-2043	2043-2044	2044-2045	2045-2046	2046-2047	2047-2048	2048-2049	2049-2050	2050-2051	2051-2052	2052-2053	2053-2054	2054-2055	2055-2056	2056-2057	2057-2058	2058-2059	2059-2060	2060-2061	2061-2062	2062-2063	2063-2064	2064-2065	2065-2066	2066-2067	2067-2068	2068-2069	2069-2070	2070-2071	2071-2072	2072-2073	2073-2074	2074-2075	2075-2076	2076-2077	2077-2078	2078-2079	2079-2080	2080-2081	2081-2082	2082-2083	2083-2084	2084-2085	2085-2086	2086-2087	2087-2088	2088-2089	2089-2090	2090-2091	2091-2092	2092-2093	2093-2094	2094-2095	2095-2096	2096-2097	2097-2098	2098-2099	2099-2100	2100-2101	2101-2102	2102-2103	2103-2104	2104-2105	2105-2106	2106-2107	2107-2108	2108-2109	2109-2110	2110-2111	2111-2112	2112-2113	2113-2114	2114-2115	2115-2116	2116-2117	2117-2118	2118-2119	2119-2120	2120-2121	2121-2122	2122-2123	2123-2124	2124-2125	2125-2126	2126-2127	2127-2128	2128-2129	2129-2130	2130-2131	2131-2132	2132-2133	2133-2134	2134-2135	2135-2136	2136-2137	2137-2138	2138-2139	2139-2140	2140-2141	2141-2142	2142-2143	2143-2144	2144-2145	2145-2146	2146-2147	2147-2148	2148-2149	2149-2150	2150-2151	2151-2152	2152-2153	2153-2154	2154-2155	2155-2156	2156-2157	2157-2158	2158-2159	2159-2160	2160-2161	2161-2162	2162-2163	2163-2164	2164-2165	2165-2166	2166-2167	2167-2168	2168-2169	2169-2170	2170-2171	2171-2172	2172-2173	2173-2174	2174-2175	2175-2176	2176-2177	2177-2178	2178-2179	2179-2180	2180-2181	2181-2182	2182-2183	2183-2184	2184-2185	2185-2186	2186-2187	2187-2188	2188-2189	2189-2190	2190-2191	2191-2192	2192-2193	2193-2194	2194-2195	2195-2196	2196-2197	2197-2198	2198-2199	2199-2200	2200-2201	2201-2202	2202-2203	2203-2204	2204-2205	2205-2206	2206-2207	2207-2208	2208-2209	2209-2210	2210-2211	2211-2212	2212-2213	2213-2214	2214-2215	2215-2216	2216-2217	2217-2218	2218-2219	2219-2220	2220-2221	2221-2222	2222-2223	2223-2224	2224-2225	2225-2226	2226-2227	2227-2228	2228-2229	2229-2230	2230-2231	2231-2232	2232-2233	2233-2234	2234-2235	2235-2236	2236-2237	2237-2238	2238-2239	2239-2240	2240-2241	2241-2242	2242-2243	2243-2244	2244-2245	2245-2246	2246-2247	2247-2248	2248-2249	2249-2250	2250-2251	2251-2252	2252-2253	2253-2254	2254-2255	2255-2256	2256-2257	2257-2258	2258-2259	2259-2260	2260-2261	2261-2262
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IV WATER PLANNING & MANAGEMENT

A. Institutions
B. Methods & Procedures
C. Basic Data

Atmospheric	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH	CI	CJ	CK	CL	CM	CN	CO	CP	CQ	CR	CS	CT	CU	CV	CW	CX	CY	CZ	DA	DB	DC	DD	DE	DF	DG	DH	DI	DJ	DK	DL	DM	DN	DO	DP	DQ	DR	DS	DT	DU	DV	DW	DX	DY	DZ	EA	EB	EC	ED	EE	EF	EG	EH	EI	EJ	EK	EL	EM	EN	EO	EP	EQ	ER	ES	ET	EU	EV	EW	EX	EY	EZ	FA	FB	FC	FD	FE	FF	FG	FH	FI	FJ	FK	FL	FM	FN	FO	FP	FQ	FR	FS	FT	FU	FV	FW	FX	FY	FZ	GA	GB	GC	GD	GE	GF	GG	GH	GI	GJ	GK	GL	GM	GN	GO	GP	GQ	GR	GS	GT	GU	GV	GW	GX	GY	GZ	HA	HB	HC	HD	HE	HF	HG	HH	HI	HJ	HK	HL	HM	HN	HO	HP	HQ	HR	HS	HT	HU	HV	HW	HX	HY	HZ	IA	IB	IC	ID	IE	IF	IG	IH	II	IJ	IK	IL	IM	IN	IO	IP	IQ	IR	IS	IT	IU	IV	IW	IX	IY	IZ	JA	JB	JC	JD	JE	JF	JG	JH	JI	IJ	JK	KL	KM	KN	KO	KP	KQ	KR	KS	KT	KU	KV	KW	KX	KY	KZ	LA	LB	LC	LD	LE	LF	LG	LH	LI	LJ	LK	LL	LM	LN	LO	LP	LQ	LR	LS	LT	LU	LV	LW	LX	LY	LZ	MA	MB	MC	MD	ME	MF	MG	MH	MI	MJ	MK	ML	MM	MN	MO	MP	MQ	MR	MS	MT	MU	MV	MW	MX	MY	MZ	NA	NB	NC	ND	NE	NF	NG	NH	NI	NJ	NK	NL	NM	NN	NO	NP	NQ	NR	NS	NT	NU	NV	NW	NX	NY	NZ	OA	OB	OC	OD	OE	OF	OG	OH	OI	OJ	OK	OL	OM	ON	OO	OP	OQ	OR	OS	OT	OU	OV	OW	OX	OY	OZ	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL	PM	PN	PO	PP	PQ	PR	PS	PT	PU	PV	PW	PX	PY	PZ	QA	QB	QC	QD	QE	QF	QG	QH	QI	QJ	QK	QL	QM	QN	QO	QP	QQ	QR	QS	QT	QU	QV	QW	QX	QY	QZ	RA	RB	RC	RD	RE	RF	RG	RH	RI	RJ	RK	RL	RM	RN	RO	RP	RQ	RR	RS	RT	RU	RV	RW	RX	RY	RZ	SA	SB	SC	SD	SE	SF	SG	SH	SI	SJ	SK	SL	SM	SN	SO	SP	SQ	SR	SS	ST	SU	SV	SW	SX	SY	SZ	TA	TB	TC	TD	TE	TF	TG	TH	TI	TJ	TK	TL	TM	TN	TO	TP	TQ	TR	TS	TT	TU	TV	TW	TX	TY	TZ	UA	UB	UC	UD	UE	UF	UG	UH	UI	UJ	UK	UL	UM	UN	UO	UP	UQ	UR	US	UT	UU	UV	UW	UX	UY	UZ	VA	VB	VC	VD	VE	VF	VG	VH	VI	VJ	VK	VL	VM	VN	VO	VP	VQ	VR	VS	VT	VU	VV	VW	VX	VY	VZ	WA	WB	WC	WD	WE	WF	WG	WH	WI	WJ	WK	WL	WM	WN	WO	WP	WQ	WR	WS	WT	WU	WV	WW	WX	WY	WZ	XA	XB	XC	XD	XE	XF	YG	YH	YI	YJ	YK	YL	YM	YN	YO	YP	YQ	YR	YS	YT	YU	YV	YW	YX	YY	YZ	ZA	ZB	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ	ZK	ZL	ZM	ZN	ZO	ZP	ZQ	ZR	ZS	ZT	ZU	ZV	ZW	ZX	ZY	ZZ	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH	CI	CJ	CK	CL	CM	CN	CO	CP	CQ	CR	CS	CT	CU	CV	CW	CX	CY	CZ	DA	DB	DC	DD	DE	DF	DG	DH	DI	DJ	DK	DL	DM	DN	DO	DP	DQ	DR	DS	DT	DU	DV	DW	DX	DY	DZ	EA	EB	EC	ED	EE	EF	EG	EH	EI	EJ	EK	EL	EM	EN	EO	EP	EQ	ER	ES	ET	EU	EV	EW	EX	EY	EZ	FA	FB	FC	FD	FE	FF	FG	FH	FI	FJ	FK	FL	FM	FN	FO	FP	FQ	FR	FS	FT	FU	FV	FW	FX	FY	FZ	GA	GB	GC	GD	GE	GF	GG	GH	GI	GJ	GK	GL	GM	GN	GO	GP	GQ	GR	GS	GT	GU	GV	GW	GX	GY	GZ	HA	HB	HC	HD	HE	HF	HG	HH	HI	HJ	HK	HL	HM	HN	HO	HP	HQ	HR	HS	HT	HU	HV	HW	HX	HY	HZ	IA	IB	IC	ID	IE	IF	IG	IH	II	IJ	IK	IL	IM	IN	IO	IP	IQ	IR	IS	IT	IU	IV	IW	IX	IY	IZ	JA	JB	JC	JD	JE	JF	JG	JH	JI	IJ	JK	KL	KM	KN	KO	KP	KQ	KR	KS	KT	KU	KV	KW	KX	KY	KZ	LA	LB	LC	LD	LE	LF	LG	LH	LI	LJ	LK	LL	LM	LN	LO	LP	LQ	LR	LS	LT	LU	LV	LW	LX	LY	LZ	MA	MB	MC	MD	ME	MF	MG	MH	MI	MJ	MK	ML	MM	MN	MO	MP	MQ	MR	MS	MT	MU	MV	MW	MX	MY	MZ	NA	NB	NC	ND	NE	NF	NG	NH	NI	NJ	NK	NL	NM	NN	NO	NP	NQ	NR	NS	NT	NU	NV	NW	NX	NY	NZ	OA	OB	OC	OD	OE	OF	OG	OH	OI	OJ	OK	OL	OM	ON	OO	OP	OQ	OR	OS	OT	OU	OV	OW	OX	OY	OZ	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL	PM	PN	PO	PP	PQ	PR	PS	PT	PU	PV	PW	PX	PY	PZ	QA	QB	QC	QD	QE	QF	QG	QH	QI	QJ	QK	QL	QM	QN	QO	QP	QQ	QR	QS	QT	QU	QV	QW	QX	QY	QZ	RA	RB	RC	RD	RE	RF	RG	RH	RI	RJ	RK	RL	RM	RN	RO	RP	RQ	RR	RS	RT	RU	RV	RW	RX	RY	RZ	SA	SB	SC	SD	SE	SF	SG	SH	SI	SJ	SK	SL	SM	SN	SO	SP	SQ	SR	SS	ST	SU	SV	SW	SX	SY	SZ	TA	TB	TC	TD	TE	TF	TG	TH	TI	TJ	TK	TL	TM	TN	TO	TP	TQ	TR	TS	TT	TU	TV	TW	TX	TY	TZ	UA	UB	UC	UD	UE	UF	UG	UH	UI	UJ	UK	UL	UM	UN	UO	UP	UQ	UR	US	UT	UU	UV	UW	UX	UY	UZ	VA	VB	VC	VD	VE	VF	VG	VH	VI	VJ	VK	VL	VM	VN	VO	VP	VQ	VR	VS	VT	VU	VV	VW	VX	VY	VZ	WA	WB	WC	WD	WE	WF	WG	WH	WI	WJ	WK	WL	WM	WN	WO	WP	WQ	WR	WS	WT	WU	WV	WW	WX	WY	WZ	XA	XB	XC	XD	XE	XF	YG	YH	YI	YJ	YK	YL	YM	YN	YO	YP	YQ	YR	YS	YT	YU	YV	YW	YX	YY	YZ	ZA	ZB	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ	ZK	ZL	ZM	ZN	ZO	ZP	ZQ	ZR	ZS	ZT	ZU	ZV	ZW	ZX	ZY	ZZ
Transfer Systems	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH	CI	CJ	CK	CL	CM	CN	CO	CP	CQ	CR	CS	CT	CU	CV	CW	CX	CY	CZ	DA	DB	DC	DD	DE	DF	DG	DH	DI	DJ	DK	DL	DM	DN	DO	DP	DQ	DR	DS	DT	DU	DV	DW	DX	DY	DZ	EA	EB	EC	ED	EE	EF	EG	EH	EI	EJ	EK	EL	EM	EN	EO	EP	EQ	ER	ES	ET	EU	EV	EW	EX	EY	EZ	FA	FB	FC	FD	FE	FF	FG	FH	FI	FJ	FK	FL	FM	FN	FO	FP	FQ	FR	FS	FT	FU	FV	FW	FX	FY	FZ	GA	GB	GC	GD	GE	GF	GG	GH	GI	GJ	GK	GL	GM	GN	GO	GP	GQ	GR	GS	GT	GU	GV	GW	GX	GY	GZ	HA	HB	HC	HD	HE	HF	HG	HH	HI	HJ	HK	HL	HM	HN	HO	HP	HQ	HR	HS	HT	HU	HV	HW	HX	HY	HZ	IA	IB	IC	ID	IE	IF	IG	IH	II	IJ	IK	IL	IM	IN	IO	IP	IQ	IR	IS	IT	IU	IV	IW	IX	IY	IZ	JA	JB	JC	JD	JE	JF	JG	JH	JI	IJ	JK	KL	KM	KN	KO	KP	KQ	KR	KS	KT	KU	KV	KW	KX	KY	KZ	LA	LB	LC	LD	LE	LF	LG	LH	LI	LJ	LK	LL	LM	LN	LO	LP	LQ	LR	LS	LT	LU	LV	LW	LX	LY	LZ	MA	MB	MC	MD	ME	MF	MG	MH	MI	MJ	MK	ML	MM	MN	MO	MP	MQ	MR	MS	MT	MU	MV	MW	MX	MY	MZ	NA	NB	NC	ND	NE	NF	NG	NH	NI	NJ	NK	NL	NM	NN	NO	NP	NQ	NR	NS	NT	NU	NV	NW	NX	NY	NZ	OA	OB	OC	OD	OE	OF	OG	OH	OI	OJ	OK	OL	OM	ON	OO	OP	OQ	OR	OS	OT	OU	OV	OW	OX	OY	OZ	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL	PM	PN	PO	PP	PQ	PR	PS	PT	PU	PV	PW	PX	PY	PZ	QA	QB	QC	QD	QE	QF	QG	QH	QI	QJ	QK	QL	QM	QN	QO	QP	QQ	QR	QS	QT	QU	QV	QW	QX	QY	QZ	RA	RB	RC	RD	RE	RF	RG	RH	RI	RJ	RK	RL	RM	RN	RO	RP	RQ	RR	RS	RT	RU	RV	RW	RX	RY	RZ	SA	SB	SC	SD	SE	SF	SG	SH	SI	SJ	SK	SL	SM	SN	SO	SP	SQ	SR	SS	ST	SU	SV	SW	SX	SY	SZ	TA	TB	TC	TD	TE	TF	TG	TH	TI	TJ	TK	TL	TM	TN	TO	TP	TQ	TR	TS	TT	TU	TV	TW	TX	TY	TZ	UA	UB	UC	UD	UE	UF	UG	UH	UI	UJ	UK	UL	UM	UN	UO	UP	UQ	UR	US	UT	UU	UV	UW	UX	UY	UZ	VA	VB	VC	VD	VE	VF	VG	VH	VI	VJ	VK	VL	VM	VN	VO	VP	VQ	VR	VS	VT	VU	VV	VW	VX	VY	VZ	WA	WB	WC	WD	WE	WF	WG	WH	WI	WJ	WK	WL	WM	WN	WO	WP	WQ	WR	WS	WT	WU	WV	WW	WX	WY	WZ	XA	XB	XC	XD	XE	XF	YG	YH	YI	YJ	YK	YL	YM	YN	YO	YP	YQ	YR	YS	YT	YU	YV	YW	YX	YY	YZ	ZA	ZB	ZC	ZD	ZE	ZF	ZG	ZH	ZI	ZJ	ZK	ZL	ZM	ZN	ZO	ZP	ZQ	ZR	ZS	ZT	ZU	ZV	ZW	ZX	ZY	ZZ																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
Hydrologic Data	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH	CI	CJ	CK	CL	CM	CN	CO	CP	CQ	CR	CS	CT	CU	CV	CW	CX	CY	CZ	DA	DB	DC	DD	DE	DF	DG	DH	DI	DJ	DK	DL	DM	DN	DO	DP	DQ	DR	DS	DT	DU	DV	DW	DX	DY	DZ	EA																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

CLASSIFICATION LEGEND:

C - Critical

N. DAKOTA

OFFICE OF
WATER RESEARCH AND TECHNOLOGY

WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: North Dakota

REGION: Missouri River Basin

DATE: 10-15-75

FISCAL YEAR

PROBLEM AREAS	Allotment		Matching			TOTAL
	110,000	250,000	50	150,000	unlimited	
I. WATER QUANTITY PROBLEMS						
A. Control of Excess Water		20,000				
B. Water Supply Augmentation and Conservation	10,000	20,000				
II. WATER QUALITY PROBLEMS						
A. Control of Entering Pollutants	10,000	30,000			25,000	
B. Effects of Pollution	30,000	40,000	10,000	25,000	75,000	
C. Water Treatment Processes and Disposal of Wastes	10,000	20,000		25,000	25,000	
III. ENVIRONMENTAL IMPACT						
A. Economic Effects	10,000	20,000	20,000	20,000	75,000	
B. Ecosystems Effects	15,000	50,000	20,000	50,000	100,000	
C. Public Welfare Effects	10,000	20,000		30,000	75,000	
IV. WATER PLANNING & MANAGEMENT						
A. Institutions		10,000				
B. Methods & Procedures	10,000	10,000			15,000	
C. Basic Data	5,000	10,000			10,000	
TOTAL					400,000	

CLASSIFICATION LEGEND

C - Critical

S - Severe



SOUTH DAKOTA'S
WATER RESOURCES PROBLEMS
AND
STUDY NEEDS

JOHN L. WIERSMA, DIRECTOR
SOUTH DAKOTA WATER RESOURCES INSTITUTE

CRITICAL PROBLEMS OF THE STATE OF SOUTH DAKOTA

<u>Problem Areas and Research Needs Descriptions</u>	<u>Problem Area(s) Coordinate</u>	<u>Research Classification Coordinate</u>
1. <u>Utilization of surface and Subsurface Waters</u>	I-B	I-E
	IV-A	III-A(s) III-D III-E(s)
Research needs include investigations on the integration of surface and groundwaters. There is a need for model development to modernize the economic use of each source with regard to type of utilization and point of use. The use of pipe lines for transport for interbasin transfers for intensive use such as rural water needs and/or marketing for industrial use needs investigation.	IV-B	III-C IV-D IV-E
	IV-C	VI-C(s)
2. <u>Improving Water Use Efficiency</u>	I-B	I-B(s) I-E V-C V-I
Research needs to be directed primarily towards the agricultural sector but includes domestic, industrial and energy generation uses. There is a need for techniques for the estimation of amount of water needed for irrigation based on soil, timing, antecedent moisture, root depths, and crop water requirement as it varies with management practices.		
3. <u>Man's Impact on Water Quality</u>	II-A	I-D I-E(s) II-D IV-B V-C V-G V-J(s)
An area of immediate concern is the relationship of point and non-point pollution to the total problem. This affects decisions to be made relative to control of the eutrophication of prairie lakes, management of reservoirs as related to sedimentation and types of land use management systems to be adapted. A unique problem exists where conservation practices are contributing to the formation of seep areas which causes the lands to be non-productive.	II-B	II-A II-B(s) II-C
	II-C	V-B(s) V-E(s)

<u>Problem Areas and Research Needs Descriptions</u>	<u>Problem Area(s) Coordinate</u>	<u>Research Classification Coordinate</u>
4. <u>Economic and Environmental Effects of Water Development</u>	I-A	I-B II-B V-A V-H
The development of the James River Valley using water from the Oahe reservoir will modify existing conditions which may cause severe and nearly irreversible changes to the physical and biological integrity of the area. Research needs to identify the modifications which will result, assess the environmental impact on various segments of the population, determine economic effect and devise means to compensate those adversely affected. The quantity and quality of irrigation return flows is of particular importance.	I-B III-A III-B III-C	I-B(s) I-C I-E(s) III-C(s) III-D II-A II-B II-C III-C(s) III-E
5. <u>Water Planning and Management</u>	IV-A	III-A(s) III-E
Research needs to be able to resolve the multi-dimensional conflicts over water allocation. This will require the development of rational, consistent, and acceptable institutional arrangements between local, state and federal governments, as well as policies and criteria for the making of environmentally sound economic decisions. Although there appears to be an abundance of water available, needs for irrigation expansion, electric power, recreation, and the emerging new water needs for coal development have precipitated conflicts about allocations. The status of Indian water rights must also be resolved.	IV-B IV-C	III-D IV-A(s) IV-D IV-E VI-A(s) VI-C(s)



OFFICE OF
WATER RESEARCH AND TECHNOLOGY

WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: South DakotaDATE: 10-13-75REGION: Missouri Basin

FISCAL YEAR 1978

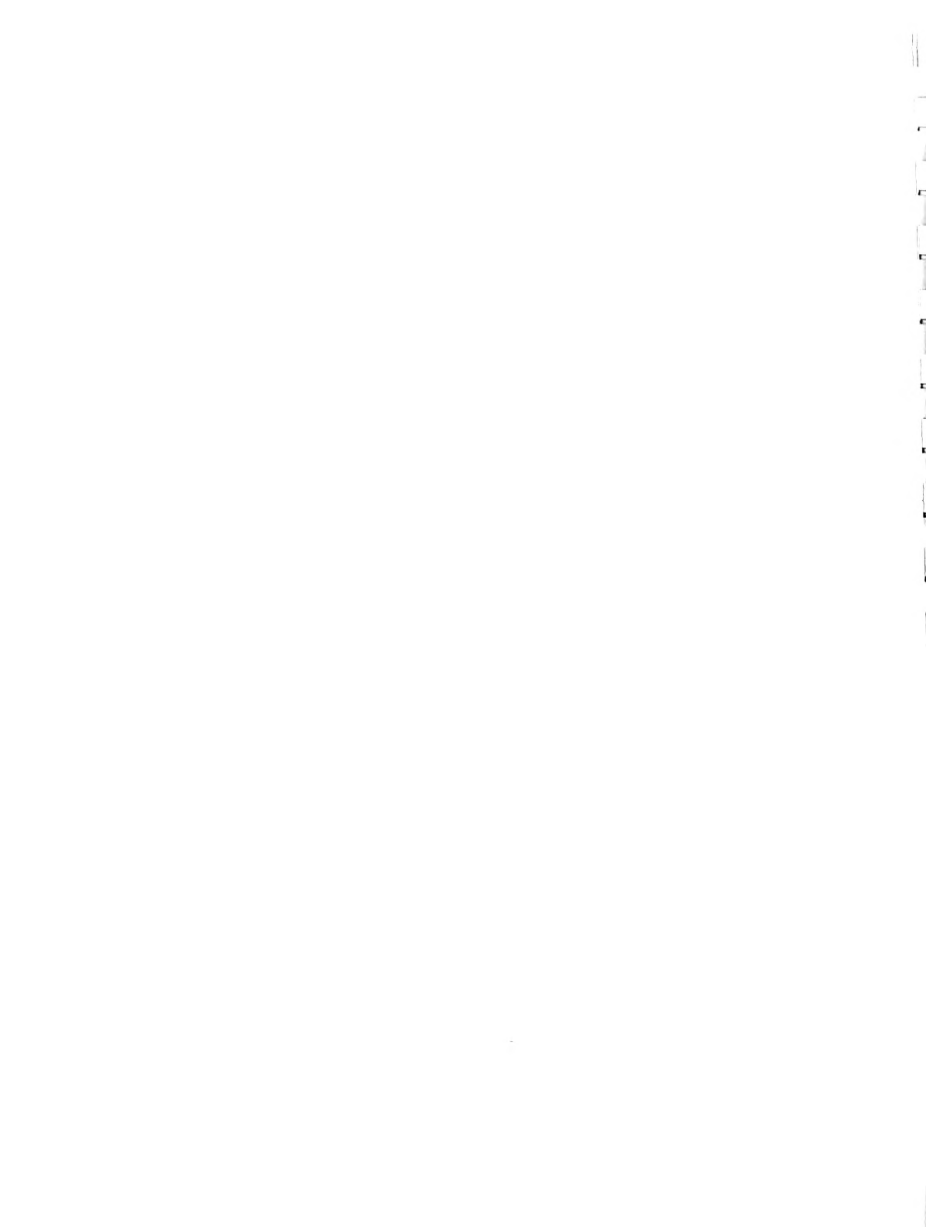
PROBLEM AREAS	Allotment		Matching			
	\$110,000	\$250,000	\$ 50,000	\$150,000	Unlimited	
I. WATER QUANTITY PROBLEMS						
A. Control of Excess Water	15,000	40,000		10,000	50,000	
B. Water Supply Augmentation and Conservation	15,000	30,000	15,000	25,000	30,000	
II. WATER QUALITY PROBLEMS						
A. Control of Entering Pollutants	20,000	30,000	5,000	15,000	30,000	
B. Effects of Pollution	10,000	20,000	10,000	20,000	20,000	
C. Water Treatment Processes and Disposal of Wastes	5,000	10,000			10,000	
III. ENVIRONMENTAL IMPACT						
A. Economic Effects	5,000	20,000	10,000	20,000	50,000	
B. Ecosystems Effects	10,000	30,000		20,000	40,000	
C. Public Welfare Effects	5,000	10,000			10,000	
IV. WATER PLANNING & MANAGEMENT						
A. Institutions	10,000	30,000	10,000	20,000	30,000	
B. Methods & Procedures	15,000	30,000		20,000	20,000	
C. Basic Data					10,000	
TOTAL					300,000	

8
8

CLASSIFICATION LEGEND

C - Critical

S - Severe



WYOMING'S
WATER RESOURCES PROBLEMS
AND
STUDY NEEDS

PAUL A. RECHARD, DIRECTOR
WATER RESOURCES RESEARCH INSTITUTE

WYOMING - CRITICAL WATER PROBLEMS

I. Water Quality

Problem

A critical problem in Wyoming for water resources research relates to the availability of water and the competition for the supply. Wyoming has a severe spacial distribution problem as regards water supply and water requirements. Some portions of the State have more surface water supply than can be consumed locally while other areas, including those of intense interest for potential coal development, have a scarcity problem. Since most of the water in Wyoming derives from snowmelt, there is temporal maldistribution of water supply as well. Compacts, treaties and court decrees also affect the ability to manipulate the available water supply for stated water demands.

Wyoming included water allocation and instream flow needs with the water quantity problem area. Probably these problems are the most pressing ones for Wyoming today. Instream flows can have a critical impact on the water supply available for development and also will affect decisions concerning water allocation problems.

Problems: I B, C, D.

Research Need

With the potential influx of industry to Wyoming, there is a need to provide the water supply necessary for industry without injuring the current agricultural economy. Industry, in many instances, is working with agriculture to develop new storage and diversion facilities and is interested in cooperative endeavors. The economics of the situation and legalities involved often control the scope of the development.

Ground water is a virtual unknown factor in much of Wyoming. Much research is necessary to define the existence and availability of ground water as a potential source of supply to industries, municipalities and agriculture.

Understanding the snowmelt process and watershed management potentials is of utmost importance in augmenting the water supplies in Wyoming. Improved watershed models, precipitation measurements and network designs are needed.

The instream flow requirements for stream and riparian ecosystems need to be defined and the criteria for determining these requirements must be established. Too often rules-of-thumb are used to estimate needs with serious impacts on water development.

Methodology for enhancing ecosystems by channel modification needs to be developed. Many times due to legal or physical constraints it is not possible to maintain a desired flow level so the best use of obtainable flows should be made. Criteria for modifying channels is sorely needed.

Processes: I B, C, E, G; II A, B; III A, B, C, D, E; IV D; V C, E, I, J; VI E.

II. Water Quality

Problem

At the present time Wyoming finds itself in the enviable position of having comparatively little quality-degraded water. However, this fact does not diminish the extent of the problem, because the maintenance of high quality water is of critical importance. With the increasing industrial development and concomitant increase in municipal supply and waste treatment, a water quality research problem exists. This is especially true with the potential pollution from mineral extraction industries.

There are some smaller communities in Wyoming which are using water of inferior quality and it would be beneficial to upgrade their supply.

With the impetus of PL 92-500, there are several communities in Wyoming considering waste treatment by irrigating with sewage effluent or total containment for evaporation. Such activities could have critical impacts on Wyoming water law, streamflow regimen, and potential uses.

Potential releases of inorganic and organic pollutants from coal mines, coal conversion plants and oil shale extraction plants may pose increasingly serious problems for Wyoming in the future. The potential accumulation of these same compounds in ground water near in situ coal conversion operations may pose a serious problem for agricultural and municipal ground water users.

Problems: II A, B, C.

Research Needs

Information on cycling, bioaccumulation and environmental effects of some potential pollutants is completely lacking, especially the organics from proposed coal conversion plants. This potential problem is particularly

serious since some of these organics are suspected or proven carcinogens or teratogens. Research must be initiated now so that water quality criteria can be established and waste treatment systems can be assigned for these compounds prior to full development of the coal conversion industry in Wyoming.

As in situ conversion experiments are initiated in this State, chemical monitoring studies on near-by ground water should be funded in order to determine the potential degree of seriousness of this problem.

The impacts of "no discharge of pollutants" on the State needs to be determined. This will require research on return flows, channel loss and gain characteristics and flow rating.

There are many instances of saline water entering streams in Wyoming due to natural causes. The increase in salt load is not always due to the influence of man; however, the source of pollution must be determined and corrective measures, if possible, defined.

Processes: I B, E; II A, B, D; III D; IV D; V C, I; VI A, B.

III. Environmental Impact

Problem

The environment of Wyoming is highly prized by resident and non-resident alike. The potential impacts of resource development, especially coal, oil shale and uranium, on the environment are of concern to everyone. A major effort is now underway to define environmental impacts of any large-scale development prior to development.

Recreational development is often made a secondary item in project development with resulting decrease in the recreational potential.

Problems: III A, B, C.

Research Needs

Specific cause and effect interactions of hydrologic and biologic phenomena need to be identified and quantified. Watershed or ecosystem models must be developed to help interpret the existing or baseline conditions and to help predict impacts of development. Methods for monitoring the environment, such as network of ground water observation wells, need to be defined. Impacts of man's alteration of stream channels for a specific purpose on the environment need to be defined. Criteria for modifying channels need to be developed.

The economic effects of environmental impacts must be quantified in some manner, because the decision makers need such tools to properly evaluate the pros and cons of development or non-development.

The public's interpretation and desires for environmental concerns need to be determined. Sociologic and political science approaches must be undertaken to more actively involve the entire "Public."

Techniques for realigning project development objectives with changing conditions need to be developed.

Processes: I A, B, C, E; II A, B; III B, C, D, E; IV D; V C, E, I;
VI A, B, C, E.

IV. Water Planning and Management

Problem

Demands for water for irrigation and coal development require efficient and effective planning and management. With increased use of and demand for water supply, it is vital that the institutions influencing the development and utilization of water provide a coordinated regional framework within which Federal, State and local governments and private industry can operate.

There have grown up conflicting sets of laws, rules and regulations within the same governmental layer and between different governmental layers. A typical example would be the municipality which is required under one Federal law to cease discharging water back to a stream yet in so doing violates State water rights laws.

Problems: IV, A, B, C,

Research Needs

Research into ways of simplifying procedures, consolidating permit requirements into fewer agencies with a consolidation of hearings, reports, and related actions and general institutional streamlining needs to be accomplished.

In some instances, rules and regulations are developed for a particular situation in one area but they are completely unnecessary in another region or area. Some methods and procedures should be developed to provide proper indices for different situations.

Processes: I E; II A, B; III D, E; IV B, D; V J; VI A, B, C, E.

RESEARCH WILL DEAL WITH THESE SYSTEMS & PROCESSES

SYSTEMS & PROCESSES
(RESEARCH)

PROBLEM AREAS	I. HYDROLOGICAL										II. BIOLOGICAL					III. SOCIOLOGICAL					IV. PLANNING & MGT.					V. ENGINEERING					VI. DATA ACQUISITION				
	A	B	C	D	E	F	G	H	I	J	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
Atmospheric																																			
Water-Soil Interface																																			
Channel Flow																																			
Lakes, Estuaries																																			
Groundwater																																			
Ice, Permafrost																																			
Watershed Ecosystems																																			
River Ecosystems																																			
Lakes, Estuaries																																			
Bio-Chemical																																			
Political Action																																			
Public Information																																			
Goal Indicators																																			
Economic																																			
Legal																																			
P&M Organizations																																			
Problem Identification																																			
Action, Design																																			
Plan Evaluation																																			
Decision-Making																																			
Operations																																			
Construction																																			
Water Treatment																																			
Wells, Recharge Sys.																																			
Flood Protection																																			
Water Supply																																			
Navigation																																			
Eutrophication Control																																			
Erosion, Sed. Control																																			
Irrigation																																			
Watershed Improvement																																			
Hydrologic Data																																			
Biologic Data																																			
Sociologic Data																																			
Engineering Data																																			

CLASSIFICATION LEGEND:

WATER RESEARCH AND TECHNOLOGY

WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: WYOMINGDATE: Oct. 1975REGION: Missouri, Colorado, Great Basin and Snake

FISCAL YEAR 1978

PROBLEM AREAS	allotment		Matching			TOTAL
	110,000	250,000	50,000	150,000	unlimited	
I. WATER QUANTITY PROBLEMS						
A. Control of Excess Water				10,000	10,000	
B. Water Supply Augmentation and Conservation	20,000	40,000	10,000	20,000	50,000	
C. Water Allocation	20,000	30,000		20,000	50,000	
D. Instream Flow	10,000	20,000	10,000	20,000	30,000	
II. WATER QUALITY PROBLEMS						
A. Control of Entering Pollutants	10,000	10,000		10,000	10,000	
B. Effects of Pollution	10,000	20,000		10,000	20,000	
C. Water Treatment Processes and Disposal of Wastes		10,000		10,000		
III. ENVIRONMENTAL IMPACT						
A. Economic Effects	10,000	25,000	10,000	10,000	20,000	
B. Ecosystems Effects	10,000	20,000	10,000	20,000	50,000	
C. Public Welfare Effects		10,000			10,000	
IV. WATER PLANNING & MANAGEMENT						
A. Institutions	10,000	15,000			20,000	
B. Methods & Procedures	20,000	40,000	10,000	10,000	10,000	
C. Basic Data		10,000		10,000	50,000	

CLASSIFICATION LEGEND

C - Critical- of immediate concern

S - Severe- but less than critical

